# Problem-based learning as a preparation for professional practice

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Cover design: Josee Driessen
Lay-out: Gideon Smolders
Printed by:
Datawyse / Universitaire Pers Maastricht

ISBN-10 90-5278-520-1
ISBN-13 978-90-5278-520-2

# Problem-based learning as a preparation for professional practice

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit Maastricht,
op gezag van de Rector Magnificus
Prof. Mr. G.P.M.F. Mols
volgens het besluit van het College van Decanen,
in het openbaar te verdedigen op

vrijdag 21 april 2006 om 12.00 uur

door

Catharina Jacoba Adriana Henrica Prince

UM
UNIVERSITAIRE PERS MAASTRICHT

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voor mijn moeder,
wat zou ze trots zijn

# Contents

# Voorwoord

Vroeger dacht ik dat onderzoek doen een saaie bezigheid was, waarbij je vooral veel alleen voor je uit zit te staren op zoek naar inspiratie. Niets is minder waar. Onderzoek is erg leuk gebleken en de inspiratie komt vooral uit de samenwerking met mensen om je heen. Ook al staat op dit proefschrift mijn naam, het is tot stand gekomen met de hulp van velen. Het is onmogelijk alle mensen die op enigerlei wijze hieraan hebben bijgedragen op deze bladzijden met naam te noemen, maar ik wil een aantal mensen toch graag persoonlijk bedanken.

Zoals gezegd, onderzoek is teamwerk en dat begint bij het project-team.
Albert Scherpbier haalde me kort voor mijn afstuderen als basisarts over om de huisartsopleiding die ik wilde gaan volgen te combineren met onderzoek van onderwijs. Niet dat het moeilijk was me over te halen. Albert, jij wist me nóg enthousiaster te maken voor onderwijs en onderzoek van onderwijs dan ik al was. Door je kritische, maar altijd opbouwende commentaar haalde je het beste in mij boven. Ik kan me niet herinneren dat ik ooit een bespreking met jou heb gehad waar ik niet gemotiveerd en geïnspireerd vandaan ben gekomen. Als ik aangaf dat het goed ging liet je me mijn gang gaan, maar in mindere tijden vond je altijd tijd in je agenda voor extra afspraken. In de loop van de tijd ben je tevens een goede vriend geworden. Bedankt voor dit alles.
Bedankt ook Cees van der Vleuten. Al je promovendi weten het: rood is goed! Jij hebt het voor elkaar gekregen dat je kritiek bij voorbaat al als positief wordt ervaren. Ook al heb je het erg druk, in tijden van nood is er nog dezelfde dag een plekje voor overleg. Bedankt Cees voor alle kennis en kunde die ik van je heb mogen leren.
Ik kan zelf nog wel eens doordraven, en de heren ook, maar dan was er Els Boshuizen. Rustig doorgraven en verdiepen, met aandacht voor de theoretische kaders. Dankjewel Els voor al je hulp hierbij.

De leden van de beoordelingscommissie wil ik danken voor de tijd die ze hebben besteed aan het lezen en beoordelen van het manuscript.

Vanaf eind 1996 heb ik een plekje gehad op het skillslab, een geweldige afdeling waar ik altijd met veel plezier heb gewerkt. Daarvoor dank ik alle (oud-) collega's. Speciale dank aan mijn collega's en alle studentassistenten met wie ik in de afgelopen jaren een kamer heb mogen delen. Met name Nelien Hylkema en Rob Dijcks wil ik bedanken voor de hele prettige samenwerking.
Jan van Dalen, onder jouw begeleiding ben ik gestart met onderzoek van onderwijs. Deze ervaring was zo goed dat ik ben doorgegaan met onderzoek, met dit boekje als resultaat. Dankjewel Jan voor je voortdurende steun, interesse in alles wat ik deed en last but not least de pret die we samen hebben gehad.

Vanuit het onderwijsinstituut leverde Ellen Kerkhofs een bijdrage door het meedenken bij organisatorische zaken. Dankjewel hiervoor Ellen. Dankjewel Lilian Swaen voor alle hulp bij het regelen van de officiële zaken. Mereke Gorsira, onwijs bedankt voor alle correcties op mijn geschrijf. Niet zomaar het verbeteren van het engels, maar met aandacht voor de inhoud en uitleg zodat ik er nog veel van geleerd heb ook.

I also want to thank all members of the department Program Evaluation Research and Development of the McMaster University in Hamilton, Canada. Special thanks to Geoff Norman, my host during the summer of 2002.

Henk van Mameren en Jan Drukker wil ik op deze plaats bedanken voor alle tijd en energie die zij hebben gestoken in het onderzoek naar anatomiekennis. Wat begon als opzet voor een kleine deel-studie werd mede door jullie een groot landelijk onderzoek. Dank jullie wel voor alle hulp hierbij.

Heel veel studenten van verschillende faculteiten, maar vooral uit Maastricht, hebben meegewerkt aan de diverse studies. Zonder heb was er geen proefschrift gekomen. Voor het onderzoek naar anatomiekennis ben ik ook dank verschuldigd aan alle artsen en anatomen die onderwerpen hebben aangedragen, toetsvragen gecontroleerd en mee hebben gewerkt aan de normstelling. Bij de toetsafnames zelf heb ik hulp gehad van diverse studenten: Björn, Patrick, Ester, Lidewij en Rob, bedankt.

Computers, statistiek, onmisbaar voor onderzoek, maar ik blijf er ruzie mee houden. Gelukkig waren Lambert Schuwirth, Ron Hoogenboom, Arno Muytjens en Robert Peperkamp altijd bereid te helpen. Lambert, dank je wel voor je hulp bij het opzetten van de anatomie-studie en het analyseerbaar maken van de resultaten en vooral voor het feit dat ik bij vragen altijd een beroep op je kon doen. Ron, geniaal zoals jij in 'een handomdraai' kunt aangeven of een groep studenten al dan niet representatief voor de jaargroep is. Bedankt daarvoor. Arno wil ik bedanken voor de adviezen en hulp bij de statistische analyses. Robert, zonder jouw hulp had ik de anatomie-toets nooit af kunnen nemen. Heren, mijn dank is groot!

Gedurende de afgelopen jaren heb ik gelukkig veel mogen samenwerken met collega-onderzoekers. Dank jullie wel, collega-aio's van O&O voor de leerzame lees-sessies en uitwisseling van onderzoeksideeën. Met name Agnes Wagenaar wil ik bedanken; we zijn vrijwel samen gestart met onderzoek op aangrenzende terreinen, samen naar ICO-cursussen geweest en nu ook allebei klaar. Hoera!
Franciska Koens, een collega-aio op afstand wil ik bedanken voor de uitwisseling van ideeën en gezelligheid op congressen. Inmiddels ben jij al gepromoveerd en een collega op het VUmc. Wie weet gaan we daar nog eens iets samen doen.

Het feit dat ik onderzoek mocht doen naast de huisartsopleiding vond ik geweldig. Bedankt Yvonne van Leeuwen, Paul Ram en Geert-Jan Dinant voor alle steun bij de combinatie van opleiding en onderzoek. Dank ook aan mijn opleiders, Anton Smulders en Bert Zonneveld, voor de flexibiliteit in de tijd die ik bij jullie in de praktijk doorbracht. De haio's en begeleiders van groep 61 (en later 64) dank ik voor de goede tijd op het instituut. Nadat ik de opleiding had afgesloten heb ik met veel genoegen het werken als huisarts kunnen combineren met onderzoek dankzij een zeer prettige samenwerking met Berthon Rikken in Utrecht en later de collega's van de UHP in Amsterdam.

Speciale aandacht voor een speciale groep: de AIOTHO's. Aanvankelijk samen opkomend voor onze rechten, groeide de band en werd het samen cursussen volgen voor onze algemene vorming en daarna de wetenschappelijke

afspraken: presentaties oefenen en artikelen bespreken, meestal erg kritisch maar toch opbouwend. Patrick, Rogier, Roelf, Marjolein, Loes, Niels, Annemiek, Paul en Wemke bedankt.

Werk is leuk, maar niet het belangrijkste in het leven. Ik ben heel blij met alle vriend(inn)en, en sommigen verdienen een aparte vermelding. Vriendinnen in goede en soms helaas ook minder goede tijden: Ciska, Janine, Ingrid en Marieke. Vanaf zo'n beetje de eerste dag in Maastricht kennen we elkaar. Dank voor jullie support, steun en gezelligheid.
Joost, dank voor de vele avonden praten over het leven en de spiegel die je me vaak weet voor te houden.
Lieve Pascale en Jacco, jullie wil ik bedanken voor alle keren dat ik mocht komen logeren, de vele gezellige en lekkere avonden in Maastricht, alle spelletjes en gesprekken. Jullie zijn supervrienden.
Nog een supervriendin: Arianthe. Dankjewel Ari voor alle motorritjes samen, de vele gesprekken aan de telefoon, op het strand of in de kroeg. Ik hoop nog veel van dit soort (mid)dagen/avonden met jou door te brengen.
Sietske bedankt voor de mental support bij de laatste loodjes en je hulp na het crashen van mijn laptop, dat heeft me heel veel tijd bespaard!
Lieve Gideon, vriend (helaas) op afstand, waardoor we elkaar minder vaak zien dan ik zou willen, maar het maakt de vriendschap er niet minder door. Enorm bedankt voor het lay-outen van dit boekje.
Lieve Annemieke, lieve Muis, jij bent echt een vriendin door dik en dun. Ik waardeer onze vriendschap zeer en ben heel gelukkig dat jij mijn paranimf wilt zijn.

Lieve Marion, Pieter, Lonneke, Jacob en Daan. Een betere 'schoonfamilie' kan ik me niet voorstellen. Dank voor alle support en voor het feit dat ik er nog een 'thuis' bij heb.

Lieve Papa, mede door jou en mama ben ik geworden zoals ik ben. Daar ben ik trots op en jullie erg dankbaar voor. Ik wil jou en Jeanne danken voor alle goede zorgen, die ik meer waardeer dan ik vaak laat blijken.
Pieter-Jan, mijn grote kleine broer. Bedankt dat jij en Irene er altijd zijn als het nodig is en me onvoorwaardelijk steunen. In verdrietige, maar gelukkig nog veel vaker in goede tijden ben jij, broertje, mijn beste vriendje. Het is voor mij dan ook niet meer dan logisch, maar toch superfijn dat je mijn paranimf bent.

Mijn laatste woorden zijn voor Peter. Niet alleen het onderzoek, maar ook onze relatie kende in de afgelopen jaren ups en downs, en het laatste jaar stroomversnellingen. Ik ben heel blij dat we het samen opnieuw hebben geprobeerd en ik hoop nog heel lang erg gelukkig met jou en onze ukkepuk Teun te zijn.

# 1
# Introduction

The ultimate objective of medical education is to produce doctors who are capable of managing the health problems of the patients who seek their services in a competent and humane manner. Therefore, medical students must acquire an essential body of knowledge and skills and the ability to use this knowledge and skills effectively in the evaluation and care of their patients. In order to be able to apply new knowledge and change their approach based on new evidence, students must also acquire lifelong learning skills, i.e. the ability to extend or improve knowledge and skills. Medical education starts when a student enters medical school and continues throughout the whole of that student's future professional life. That is why we refer to it as the medical education continuum.

Several developments in medicine and society in general require continuous updating of medical education. For example, the body of medical knowledge (basic science knowledge as well as clinical knowledge) is growing exponentially. No medical school can possibly teach all the knowledge and skills that may eventually be needed by their students. And even if they could do so, much of that knowledge would be forgotten or outdated within several years. Current technical developments, changes in the composition and health of the population and changes in the organisation of health care demand frequent reconsideration and adaptation of medical education. Educational re-evaluation should focus on *what* is learned in medical school, and on *when* (undergraduate medical training, postgraduate training etc) and *how* it is learned.

The knowledge explosion of the last few decades has been accompanied by a decreasing reliance on traditional (didactic) teaching. This educational paradigm shift (from teacher-centred to student-centred education) has been led by widespread endorsement of problem-based learning (PBL). PBL was originally conceived to improve students' ability to reason and communicate and it has rapidly gained momentum apparently in response to the information overload in medical school curricula and to calls to increase the relevance of basic sciences training to clinical practice in undergraduate medical education and improve students' skills to apply their knowledge.

**What is PBL?**

Problem-based learning (PBL) had its roots at McMaster University, Canada, in the late 1960s. It stands in contrast to passive memorisation of knowledge from lectures and readings, which can be seen as the principal method of learning in many medical schools until then (and in many schools still). Problem-based learning was introduced to provide a context for learning, because that would demonstrate the significance of what students have to learn. Furthermore it provides students with an opportunity to apply new facts or concepts they have acquired in working towards solutions of realistic problems.[1]

In the past 40 years, PBL has been adopted, with variations, across many disciplines (also other than medicine) in many countries. The term PBL has been used with reference to different concepts and it has been given different meanings. PBL in medicine is best described as an instructional method that is characterised by the use of patient problems as the context in which students acquire problem-solving skills and knowledge about basic

and clinical sciences. What distinguishes PBL from other student-centred methods is that in PBL the problem is presented before students learn basic science or clinical concepts, not after.

Basically, in PBL, students are provided with so-called stimulus or trigger material, for example a written description or a videotape of a patient or a real patient with a problem. Students work co-operatively in small groups. They identify problems, they use prior knowledge when they are brainstorming to find an explanation for the problem, and they formulate learning goals. The students then attempt to fill gaps in their knowledge through individual study and inquiry and share their findings and try to integrate the new knowledge into a comprehensive explanation for the phenomena or problems they have to resolve.

According to Barrows, PBL had potential for addressing a number of objectives, which can be summarised as follows:

1) To increase motivation for learning by providing a context for learning. In this way PBL enables students to perceive the relevance of their studies and the challenge of solving problems provides motivation for learning;
2) To structure knowledge for use in clinical contexts; learning that is driven by the challenge of a patient problem and integrated into the reasoning required to evaluate and resolve patient problems promotes structuring of knowledge to support practice;
3) To develop effective clinical reasoning processes; by repeated practice and feedback, effective and efficient clinical reasoning processes are acquired;
4) To develop effective self-directed learning skills; students need to become sensitive to their personal learning needs and be able to identify and make proper use of appropriate information resources; these abilities are prerequisites for self-assessment and self-directed learning.[1]

PBL was mainly introduced in preclinical medical education as an alternative to the traditional first 2 to 4 (basic science) years of medical school. There is little information about PBL in the clinical years of undergraduate medical training.[2] Dornan et al. showed that so far, clinical teaching in PBL clerkships has retained most or all of the features of traditional learning (teacher directed, unsystematic, discipline specific and ward based).[3]

**Theoretical support for PBL**

PBL has evolved out of the needs of professional practice, as a new idea without firm theoretical support. Education has been professionalised over time and since the introduction of PBL many authors have provided rationales for PBL as an instructional method based on various learning theories.[4] PBL as an educational concept has several aspects in common with contemporary educational and learning theories. Some of the similarities and differences will be discussed here.

*Cognitive psychology* informs us that one of the most important features of memory is its associative structure. Knowledge is structured in networks of related concepts. Learning can be viewed as a constructive process.[5] As learning occurs, new information is linked to existing networks and connections between concepts are made or strengthened. Students are better

able to construct new knowledge when they can relate it to what they already know.[6] Dependent on the way this is done by learners, new information may be retrieved more or less easily and used to solve problems or recall facts.

In order to optimise learning, education has to meet several conditions according to the information processing approach to learning by Anderson.[7] This theory postulates that three principles play a major role in the acquisition of new information: activation of prior knowledge, encoding specificity and elaboration of knowledge.[4,7] Activation of prior knowledge refers to students using their extant knowledge to understand and structure new information. Encoding specificity refers to the phenomenon that knowledge retrieval is facilitated when the situation in which it was learned resembles that in which it has to be applied. The closer the resemblance, the more likely the successful retrieval of knowledge. The third element, elaboration of knowledge, refers to the fact that information will be better understood and remembered if there is opportunity for elaboration (discussion, answering questions, etc.). Schmidt argues that information-processing theory is in line with PBL.[4] Presented problems will activate prior knowledge, provided some prerequisites are met, such as a description that invites explanation and a degree of complexity that is adapted to students' prior knowledge. Problems are used that have a close resemblance to the type of problems that students will come across in their future professional lives. Students provide each other with opportunities for amplification and modification of existing knowledge structures and in the last step of the PBL procedure, newly acquired information is exchanged, critically discussed and applied. These activities can all be viewed as elaboration processes. PBL is thus supposed to enhance acquisition, retention, and use of knowledge by activating prior knowledge and by inviting elaboration.[8]

The *situated learning theory* claims that 'learning to do' (closely related to 'knowing how') takes place through problem solving in context.[9] It questions the principle of separating learning from practice and challenges professional education by questioning the value of knowledge transmitted by instruction, typically within educational institutions. Situated learning theory departs from the situation in which and for which students are learning. Others have translated this assumption of situated learning theory into solutions that can be managed within school bounds. Authentic problems and authentic environments play a crucial role. Instructional design for situated learning emphasises perception and action over memory and retrieval, and comprises four elements: appropriate 'generator' situations; work scaffolding within which novices and experts can work alongside each other; adequate support to develop the tutor's coaching role; and student assessment processes that incorporate the interaction of the student with the situation.[10] The medical education literature makes only limited reference to situated learning.[11] Although in PBL students are not part of a community of practice, the idea behind PBL is similar to situated learning, that is, to present students with challenging authentic problems derived from real practice. PBL integrates knowledge across conventional boundaries and within a clinical context, which is in line with situated learning theory. However, the PBL group is not the 'workplace' of situated learning theory; the latter is sometimes represented as claiming that effective vocationally related training must be work based, which is not the case in PBL (where students do not work

alongside professionals from the beginning of their education).

The PBL process mirrors Knowles' context for supporting *lifelong learning.*[12] PBL particularly addresses self-directed learning (SDL). SDL has several components:

1) students need to be able and motivated to self-assess and identify their specific learning needs;
2) students need to be able and motivated to wisely and efficiently identify, locate, access, and use a range of relevant resources to address their identified learning needs;
3) students need to be able to critically evaluate the scope and accuracy of the selected resources; and
4) evaluation of the resultant learning outcomes and their effects on the learner's practice.

In PBL, students learn to access up-to-date information resources efficiently and habitually; interaction between learners enhances critical reflection through multiple perspectives and scenarios are used that attempt to recreate realistic 'life situations' for building examples (instances) and using experience. This should prepare learners in PBL for lifelong, self-directed learning.

A neglected aspect of cognition that likely plays a role is the broad domain of affect and motivation. In the context of information processing, positive emotion provides a context for related material, facilitates recall of associated information, and promotes greater involvement with the information and the problem at hand. Negative motivation reduces the ability to fit information into existing schemas and generally obstructs information retrieval.

From a *motivational perspective*, PBL is assumed to enhance students' intrinsic interest in subject matter. Students discover what they do not yet fully understand and become engaged in the subject at hand.

*Collaborative learning.* The motivationalist critique of traditional classroom organisation holds that competitive grading and the informal reward system of the classroom create peer norms that are detrimental to academic efforts. When students are encouraged to collaborate toward a common goal, they may be motivated to reinforce each other for academic efforts. Members of cooperating teams outperform individuals who are competing with each other.[13]

Notwithstanding the many studies in the field of cooperative learning, there is still a great deal of confusion and disagreement about why cooperative learning methods affect achievement and, even more importantly, under what conditions cooperative learning has these effects.[14] A possible explanation is that groups develop team spirit, which encourages the group members to care about the group because they wish it to succeed.[14]

**Evidence for the effects of PBL**

As PBL is in line with some psychological and educational theories, it can be expected to have a positive effect on learning. We will discuss the evidence that PBL is effective as a learning method. We will confine ourselves to medicine. As mentioned earlier, PBL has several objectives. According to

Barrows, these objectives are:

1) Increased motivation for learning,
2) Structuring of knowledge for use in clinical contexts,
3) Developing an effective clinical reasoning process, and
4) Developing effective self-directed learning skills.[1]

Some of these objectives have been proven to be outcomes of PBL. For example, there is consistent evidence that PBL students like their education more and use an approach to learning that is somewhat different compared to that of students in non-PBL programmes.[15, 16]

So far no research has clearly shown that problem-based learning is educationally superior to the conventional curriculum as regards knowledge or the structuring of knowledge for use in practice. Three comprehensive reviews in the 1990s by Albanese and Mitchell, Berkson, and Vernon and Blake, respectively showed no convincing evidence for the effectiveness of PBL in fostering the acquisition of basic knowledge and clinical skills.[15-17] There are a few studies that have shown that PBL students performed less well on basic sciences and better on clinical examinations than conventional track students. However, the effects were small at best and easily accounted for by pre-existing differences. Colliver reviewed the medical literature published after these reviews (from 1993 through 1998) and failed to reveal convincing evidence that PBL improves the knowledge base and clinical performance.[18] A recent systematic review by Newman et al. reported that studies on PBL generally provided insufficient description of the intervention that was called PBL. The results of the studies were mixed, some favouring PBL and others not.[19] A meta-analysis by Dochy et al. showed that the differences in knowledge-related outcomes encountered in the first and second years disappeared later on.[20] A remarkable finding related to the retention period was that students in PBL gained slightly less knowledge, but remembered more of the acquired knowledge.[20] Thus students may not acquire more knowledge, but remember more of it after a delay. There is some evidence that students from PBL curricula show better diagnostic performance, compared to students from conventional curricula.[21, 22]

The third objective of PBL according to Barrows was to develop effective clinical reasoning skills. Research has shown that problem-solving skills are not generic teachable skills aside from content. Norman reviewed research on clinical reasoning and concluded that expert clinical reasoning is a consequence of an extensive and multidimensional knowledge base.[23] Thus, problem-solving skill, one of the original objectives of PBL, has been proven not to exist as a general, content-independent, teachable skill.

There is a paucity of literature on the effects of PBL on the development of effective self-directed learning skills. Some studies have shown that PBL students exhibit different study patterns compared to conventional curriculum students, e.g. they use more journal articles, electronic searches, books and self-selected resources.[16] A study by Shin and colleagues indicated that graduates from a PBL curriculum stayed more up to date in their knowledge when in practice.[24] Hmelo-Silver showed that PBL students transferred the hypothesis-driven strategies from their problem solving into their self-directed learning as they used their hypotheses to plan their

learning. Moreover, they were more likely to integrate new information into a revised explanation than were traditional medical students.[25]

In conclusion, PBL increases the motivation of students and possibly leads to better self-directed learning. However, there is no conclusive evidence of superior outcomes of PBL as an educational method in terms of superior knowledge structure or problem solving skills.

The evaluation studies so far have several limitations. Firstly, we have to take into account the high quality of medical students. Medical schools the world over are highly selective in admitting students. Therefore, medical education is delivered to strongly motivated students who possess eminent intellectual capacities and who are likely to learn well by whatever means they are taught and very capable of compensating for bad teaching in their learning. Therefore it will always be very difficult to find clear proof of cognitive differences between educational methods.
Secondly, PBL as currently practised comprises a heterogeneous mixture of philosophy, values, role behaviours, curriculum design and teaching methods. Therefore, results of various studies are hardly comparable. Finally, most studies on the effects of PBL as an educational method use knowledge and skills as outcome measures. Although these are important competencies, they are not necessarily the best yardstick for evaluating PBL, given that PBL may well have other benefits. Professionalism is increasingly emphasised in medical education. Non-cognitive goals, including skills to work in a team or take responsibility, are increasingly coming to the forefront of education and research. The primary contribution of PBL may lie in the acquisition of generic competences or personal transferable skills, such as communication and teamwork, which are essential for all graduates of higher education. However, these outcome measures are very difficult to assess indeed.

The ultimate goal of medical training is to prepare students for medical practice. Characteristic of all the theoretical viewpoints discussed above is that they contextualise education, i.e. enhance its relevance by attaching professional context. The purpose of all this is to facilitate transfer of what has been learned and to teach students skills that can be used in practice. Instead of examining hypotheses about detailed variables on which PBL might have an effect, it seems more useful to test whether or not PBL does indeed prepare students better for practice and whether or not students from a PBL medical school suffer less from negative effects of the transition from theory to practice. There is hardly any research on the question whether or not PBL actually prepares students better for practice or makes the transition from education to practice easier or less stressful.[26]

**Aims of the studies presented in this thesis**

The purpose of this dissertation was to examine to what extent PBL prepares students for practice. The following research questions were addressed:

1) How do medical students and graduates perceive the transition from theory to practice? What goes well and what does not go well? What kind of problems do graduates and students encounter? and
2) What is the role of PBL in their perceptions? Does PBL enhance students preparedness for practice?

In the preceding, other studies were criticised for often focusing too much on details. This thesis is intended to examine more broadly how well students and graduates feel prepared for practice. To investigate the research questions one particular medical school was chosen as the setting for the studies. The conclusions will be based on insights into the PBL process of Maastricht Medical School. Therefore the conclusions will have to be interpreted in the light of the specific implementation of PBL at Maastricht. As this requires a good understanding of the Maastricht approach to PBL, this will be presented before the structure of the thesis is outlined.

### Maastricht Medical School

Dutch undergraduate medical education lasts 6 years. Graduates are entitled to register as a licensed medical doctor. Many doctors take non-training posts in a hospital to gain experience before entering specialty training.
At the time of the studies presented in this thesis, Maastricht Medical School offered a problem-based curriculum in the four preclinical years of the curriculum. Years 5 and 6 consisted of clerkship rotations in hospital departments and general practice. In the first four years there were six-week block courses devoted to specific themes. Students met twice weekly in small groups with a tutor to work on 'problems'. The problems in the first two years dealt with the normal functioning human body and consisted of a description of a set of phenomena in need of explanation. In years 3 and 4 the problems focused on abnormal functioning and most of the 'problems' were patient cases. The groups were chaired by one of the students; and students took turns leading the group discussion. Besides providing information in free-inquiry cases, the tutor critically followed the group discussions, only intervening to stimulate students' thinking and interaction. In addition to the two weekly group sessions, students could attend one or two lectures per week. In the four preclinical years, the Skillslab offered a longitudinal skills training programme. The programme consisted of physical examination and laboratory skills as well as controlled and systematic training in communication skills, including consultations with simulated patients in which students played the role of the doctor.[27] The assessment programme comprised four progress tests every year, integrated unit-related, end-of-block tests and annual OSCEs to test clinical skills. All tests were submitted to a careful review procedure by interdisciplinary review committees.[28]
PBL as implemented in Maastricht can be seen as a curriculum concept, not just an educational method. For optimal integration of subjects, multidisciplinary teams designed the blocks around themes that represented the main problem fields encountered in Dutch health care. The themes and learning objectives were determined by an educational committee and operationalised by the block planning groups. All educational activities (tutor group sessions, lectures, clinical training sessions, but also patient contacts etc.) were linked to the block theme and served as learning aids to the students.[29]

### Outline of this dissertation

The aim of this thesis was to examine students' and graduates' opinions about the transition from theory to practice. Almost everywhere, undergraduate medical training is composed of a theoretical part, the preclinical curriculum, and a more practical, clinical phase, often taking the form of clerkships. The transition from the theoretical phase of the curriculum to the more practical

part confronts students in most medical schools with a rather sharp divide. Thus the starting point of the research was how students perceive this transition from the mainly theoretical preclinical phase to the practical phase of undergraduate medical training.
The first two studies reported in this thesis investigated students' perceptions on the transition from the preclinical to the clinical phase of the curriculum. Two methods were used: a focus group study was performed to inventory and conduct an in-depth investigation of students' perceptions and opinions. The results are described in Chapter 2. A survey study among a larger, more representative sample of clerks was used to quantify the results of the focus group study. The results of this survey are reported in Chapter 3.

One of the striking findings of the first two studies was that PBL students felt rather deficient in basic science knowledge, particularly in anatomy and pharmacology. The students claimed that the integrated approach to learning or, rather, the lack of dedicated courses caused uncertainty, with the result that students perceived themselves as being inadequately prepared for clinical practice. This finding is in strong contrast with one of the claims about the advantages of PBL, i.e. that it promotes the integration of basic and clinical science and hence the practical applicability of basic science knowledge. This issue inspired the following two studies:

The study described in Chapter 4 investigated the integration of basic and clinical sciences in the domain of functional anatomy. In order to determine whether PBL students have different levels of knowledge compared with their peers from other medical schools, we tested students from all eight medical schools in The Netherlands. Anatomy was chosen as the subject for evaluation as this was the basic science that most often gave rise to concern about its continued place in the undergraduate medical curriculum. Because we did not want to make only a relative judgment (Maastricht students versus other students) but also an absolute judgment, we used a modified Angoff procedure to test the expectations of several groups of judges and compared the students' results to the Angoff standards. The results of these studies on anatomy knowledge are described in Chapter 5.

A second sharp contrast is experienced by students when they make the transition from undergraduate to postgraduate medical training. The next question was how do graduates experience the transition from theory to practice? Are there differences between the experiences of PBL and non-PBL graduates and what is the effect of PBL in that? More specifically, we wanted to know what effects PBL had on specific knowledge and skills as well as on more generic skills.

In chapter 6, the perceptions of PBL and non-PBL graduates with respect to this transition are studied. To study the perceptions of PBL graduates in greater depth we analysed the perceptions of graduates qualitatively (chapter 7). We examined junior doctors' opinions about this transition by focus group interviews with graduates from a PBL medical school, both on specific and generic knowledge and skills.

Chapter 8 presents the general discussion of this thesis. In this chapter the transition from the pre-clinical tot the clinical phase of the curriculum and

the transition from undergraduate training to postgraduate training are discussed. Recommendations are made for further research and educational development.

This thesis is based on articles that were published separately. Hence some repetition was inevitable.

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# De overgang naar de praktijk

Ik vond het in ieder geval behoorlijk eng om te beginnen: in een ziekenhuis, in een witte jas. In het begin werden we wel goed opgevangen door de onderwijscoördinator, maar meteen daarna werden we in het diepe gegooid toen we patiënten moesten statussen. De eerste dagen is het echt op je tenen lopen. Je ziet allemaal verschillende mensen. Je krijgt honderd nummers van seinen en codes voor dit en voor dat. En als je dat niet op tijd opschrijft vergeet je het. Je weet niet waar je moet zijn en loopt dan maar ergens naar toe. Als je foto's moet ophalen bij radiologie blijk je daar weer een kaartje voor te moeten hebben en kun je weer terug. Dus eigenlijk loop je in het begin van hot naar her en ben je aan het eind van de dag bekaf. Maar het is wel leuk.

(citaat focusgroep onderzoek)

# 2
# A qualitative analysis of the transition from theory to practice in undergraduate training in a PBL-medical school

Published as: Prince KJAH, van de Wiel MWJ, Scherpbier AJJA, van der Vleuten CPM, Boshuizen HPA. A qualitative analysis of the transition from theory to practice in undergraduate training in a PBL-medical school. Advances in Health Sciences Education 2000; 5: 105-16.

## Abstract

In spite of numerous curricular innovations, the problems medical students encounter in making the transition from theoretical training to clinical training remain unresolved and the problem has received scant attention in the literature. We performed a qualitative study to explore students' perceptions and attitudes regarding this transition in undergraduate medical training. Twenty fifth-year students of the Maastricht Medical School participated in focus group discussions about the transition from the pre-clinical phase to the clinical phase of the curriculum. All focus group discussions were videotaped, literally transcribed and qualitatively analysed using content analysis.

The results suggest that students have difficulty in bridging the gap between the theoretical and clinical phase of the curriculum. The problems they experience arise largely from professional socialisation processes. However, students also find it difficult to apply theoretical knowledge in clinical practice. Students find contacts with real patients highly motivating. In the clinical phase their learning changes from passive acquisition of knowledge to more active learning.

Since the problem-based learning approach is supposed to enhance application of basic science concepts to clinical problems, it is surprising that students experience difficulties in applying their knowledge in practice. To facilitate the transition from theory to practice in the Maastricht Medical School some curricular changes could be introduced, such as early patient contacts to motivate students and help them learn usable knowledge. Furthermore, the advantages of a problem-based pre-clinical curriculum to student learning should be fully exploited. Finally, the assessment system must be congruent with the educational programme, because examinations have a powerful effect on student learning.

## Introduction

Since the 1950s, medical schools have introduced multiple innovations to ease the transition from the pre-clinical phase of the undergraduate medical curriculum to the clinical clerkships. The main characteristics of these curricular innovations can be summarized as follows: problem-based rather than discipline-based education, integration of basic sciences and clinical sciences throughout the curriculum, and the development of higher cognitive skills besides the acquisition of knowledge.[1] Insights from cognitive psychology supported these innovations. Norman and Schmidt concluded that PBL facilitates the transfer of concepts to new problems, the application of basic science concepts to clinical problems, intrinsic interest in the subject matter and self-directed learning skills.[2] The primary objective of the innovations was optimal preparation of students for clinical practice. However, the innovations have largely been restricted to the pre-clinical phase, with conventional clerkship programmes remaining unaffected.[3] Thus, in many medical schools the dichotomy between theory and practice is perpetuated.

The literature on the preparedness of medical graduates for practice and the role of education is extensive.[4-7] However, the transition from the theoretical phase to the clinical phase within the undergraduate medical curriculum has been less well studied. There is some evidence that this transition is difficult for students and that it affects their learning progress. Boshuizen and Schmidt found indications that the start of the clinical clerkships causes a discontinuity in the building up and encapsulation of biomedical knowledge.[8] Boshuizen demonstrated a marked decrease in fifth-year students' ability to apply biomedical knowledge in the clerkship period.[9] Other research found evidence of a temporary decrease in skills-related knowledge in the first clerkship year.[10] There is no reason to assume that students actually forget what they have learned when they start training in the clinical setting. Rather, students appear to go through a 'crisis' in their learning process. This may be attributable to the sharp demarcation line between the theoretical and clinical phases of the medical curriculum.

To obtain a better insight into students' experiences and opinions with regard to the transition from theory to practice we used focus group discussions to answer the research question: what are students' perceptions and attitudes about the transition from theory to practice in undergraduate medical training. Fifth-year undergraduate students of the problem-based Maastricht medical school who had just entered their clerkships participated in two focus group sessions. The students' opinions are presented in this chapter and illustrated by quotations from the discussions.

### Context of the study

The Dutch medical school curricula consist of four pre-clinical years, where the emphasis is mostly on theoretical knowledge, followed by two years of in-service training in hospital wards and family practice, known as clerkships. The Maastricht Medical School attempts to bridge the gap between the theoretical phase and the clinical phase of the curriculum by applying PBL and early clinical skills training in the pre-clinical phase. PBL requires students to acquire knowledge by using real-life problems as

a learning context. This approach is supposed to stimulate self-directed learning, promote the acquisition of lifelong learning skills and integrate disciplines both horizontally (multiple disciplines integrated in one unit) and vertically (basic and clinical sciences). From the first day in medical school, practical skills are taught in the Skillslab. The Skillslab is a department of the medical school that provides training courses in physical examination skills, therapeutic skills, laboratory skills and communication skills. Students learn skills separately, mastering each skill in a controlled systematic manner.[10, 11] Over the first four years students are offered various simulated patient contacts. Clinical rotations start at the beginning of the fifth year, either in surgery, internal medicine, psychiatry or with an elective.

## Method

### Focus groups

Focus groups are group interviews in which participants' opinions on the topic(s) of interest are explored. Group interaction is explicitly used as part of the method, based on the idea that group processes can help people to explore and clarify their views in ways that would be less accessible in a one-to-one interview. Focus group research is particularly useful for the exploration of a new field and to generate hypotheses based on informants' insights. The reliability of the data is established by comparing statements across sessions.

The comparative strength of focus groups as an interview technique is the opportunity to observe interaction about a given topic. The relative weakness is that the researcher has less control over the data that are generated.[12] The use of focus groups to obtain qualitative information has become an established procedure in a variety of settings, including medical education research.[13, 14]

### Participants

Forty students were randomly selected from all fifth-year students (n = 150) of Maastricht Medical School in the academic year 1996/1997. They were invited to participate in a focus group by letter and/or telephone. Of the 40 students, seven could not be included because they had not started their clinical rotations, had already finished their first year of clinical rotations or were doing an elective abroad. Of the remaining 33 students, 26 (79%) were willing to participate. Six students were not available on the selected dates, leaving a total of 20 students that participated in the study. The representativeness of the participating students was assessed by comparing their prior scores on the progress test with those of the total class. The progress test is administered to all undergraduate medical students of Maastricht Medical School on four occasions in every academic year. No differences were found between the participating students' scores and those of the other students in their class.

The twenty students were assigned to three groups according to availability (7, 5 and 8 participants, respectively). The average time students had spent as clerks was 19.6 weeks (range 5 to 38). Sixty-five percent were female (n=13), which is comparable to the distribution in the entire student population. The

majority of the students had started their clerkships in the department of surgery, the others in the departments of internal medicine or psychiatry, or with an elective. Students were paid 75 guilders for their participation in two focus groups and for critical comments on the final report.

### Procedure

Two of the three focus groups met in July and one in September 1997. Each group met in two two- hour sessions, which were scheduled after working hours to prevent interference with students' clinical work. The sessions were moderated by the researchers. The first moderator, KP, is a recent graduate of Maastricht Medical School and thus familiar with the curriculum; the assistant moderator, MW, is a psychologist and experienced in conducting focus group research. The first moderator guided the discussions, while the assistant moderator took notes and asked for elucidation when the discussion became vague.

In the first meeting students were asked to recall their first clerkship: "Looking back on your first week as a clerk, can you tell us about your experiences, your overall impression?" They were also asked to describe any problems they had encountered and suggest solutions. To conclude, we asked them for their views regarding the transition from theory to practice and the training programme prior to and during the clinical rotations. In the second meeting a summary of the first session was discussed and opinions were checked and clarified.

### Data collection and analysis

All focus group meetings were recorded on videotape, which were audio converted and literally transcribed. The transcripts were analysed by the first moderator, who discussed the analysis with the assistant moderator. The first stage of the analysis involved going through the transcripts to identify recurring themes. Subsequently, the information was reorganised according to these themes, rephrased and summarised in a report. The students checked their group's report in a cross-validation procedure, to make sure that it adequately reflected their intentions. All students agreed that the report was accurate and complete. There were a few comments, mainly concerning sentence structure and a shift in emphasis, and the reports were revised accordingly. Finally, the data from the three groups were aggregated.

## Results

The topics that were raised spontaneously by students in all three groups were almost identical. All three groups discussed the same themes, namely the transition from the pre-clinical phase to the clinical setting and its social implications; the contacts with real patients; students' perceptions of their level of knowledge and practical skills; and their learning styles and behaviour. In Table 1 the topics are summarised as categories and students' remarks on the respective themes are summarized as keywords. Within each group opinions on some topics varied and experiences differed from person to person. Where there were differences of opinion, both sides are reflected. The topics will be discussed consecutively

Table 1: Categories and keywords summarizing the topics discussed.

| Category | Keywords |
|---|---|
| Transition | difference between theory and practice |
| | feelings of insecurity |
| | social implications |
| | fatigue |
| | long hours |
| | satisfaction with overall level of preparation |
| Contact with real patients | easy |
| | patient contact different from paper cases |
| | difficult to use patients as learning tool |
| Knowledge | never knowing enough |
| | basic science deficit |
| | knowledge reversely structured |
| Practical skills | well prepared |
| | difficulty in recognising pathology |
| | patient records and patient presentations |
| | observation during physical examination |
| Learning | amount of time spent studying |
| | another way of studying |
| | learning objectives |
| | patients increase motivation |

## The transition

All students in all groups reported having experienced a dramatic difference between the theoretical and practical phase of the curriculum. Typical remarks were:

> "There was a big difference between the tutorial groups and playing a part in the real world, where things actually happen. Then you realise what is going on: it is about real things, no stupid theoretical facts anymore; real patients who could die". (HG1)
>
> "(..) from learning we had to switch to using our knowledge in practice". (EB3)

Students reported feeling insecure because they did not know what was expected of them. A more extensive introduction might have made matters easier, but even then, their prime concern in the first few days or weeks would have been with how to behave and act rather than with learning.

> "In the beginning I was occupied with what the physician wanted and with filling out papers, rather than with patients or learning". (SJ2)
>
> "I had to assist in the theatre, where I was so occupied with my hands and holding the retractors that afterwards I was unable to tell what kind of operation had been performed". (HG1)

Being alert all the time and adapting to their new environment required considerable effort, not only mentally but also physically because of the long hours they had to work. All students reported that their social life had changed dramatically as a result of the clerkship. As pre-clinical student they could plan their own day schedule. As clerks they had to work all day and study in the evenings. Most students reported working about 70 hours a week. They were not accustomed to working this hard. Typical remarks were:

> "The first week is so tiring, all these impressions, people who die, introducing yourself to everyone and always showing your best side". (BC2)
>
> "There is a vast difference, whether you can loaf around all day, do your shopping, or whether you have to work all day, get home at 7 p.m. and have to study the whole evening". (MV1)

Nevertheless, students expressed satisfaction with their overall preparation. Students with more experience with patients, for instance after an elective abroad, found the transition easier than students with hardly any previous patient contacts.

**Contact with real patients**

Students reported that their first contacts with real patients had been relatively easy. They judged the contacts as:

> "the nicest thing in the whole clerkship" (RV2) and
>
> "immensely better than expected". (EB3)

Students reported that the paper cases that were used in the tutorial groups in the first four years did not resemble the problems they saw in practice. The patients were real and alive and no paper case could ever simulate the emotions shown by these ill people. Indeed students proposed that more contacts with real patients should be scheduled earlier in the curriculum.

Initially, some students were hesitant about doing a physical examination, but they quickly became used to it. The only problem indicated by some students was their embarrassment about using patients as teaching aids. Students found it particularly hard to cope with situations where a patient who had already gone through it all, had to undergo yet another physical examination merely for the sake of the student learning by experience. They felt they were intruding.

**Knowledge**

Many students' first comment with respect to their level of knowledge was that it was insufficient. In the subsequent discussion most students realised and agreed that the clinical years were meant for learning and almost all students adjusted their earlier comments. Students indicated that their knowledge was adequate, but that they felt uncertain and that the knowledge they had was not readily available to them, although this varied from student to student.

Students reported specific problems concerning basic science knowledge. They mentioned deficiencies with respect to anatomy, pharmacology and interpretation of laboratory results. Although these disciplines had been covered in the pre-clinical curriculum, many students had paid little attention

to them, mostly because these subjects did not seem interesting and their relevance had been unclear. Students recommended separate anatomy training early in the curriculum and separate assessment.

"I didn't study anatomy well, but I did pass all my exams. By now I know how stupid I was, but at the time I didn't care, I was just not interested. Now I regret not having studied harder for anatomy". (HJ1)

Two of the three groups spontaneously said that knowledge had to be 'structured the other way around'. In the first years of the curriculum they had learned 'from theory to practice'. Although the cases used in the tutorials were realistic, students said they discovered the correct diagnoses within minutes and did not really formulate appropriate learning objectives. Students reported a tendency in most tutorial groups to start studying by looking up a diagnosis and the symptoms associated with it. In the clinical setting, however, they were confronted with patients, presenting with complaints and symptoms for which they had to find the diagnosis. The third group did not mention this spontaneously. They agreed that in the clerkships they worked from practice to theory, something they were not used to, but they did not consider this a major problem. Quotations:

"It is totally reversed, now I have to think from symptoms, whereas I used to study from diagnoses". (SJ2)

"It struck me that we have learned everything the other way around from how you see it in practice. We do not see a patient with a heart attack, we see a patient with certain symptoms and we have to find out what it is". (HJ1)

"Integrated thinking is not learned until the clerkships". (MA2)

As an explanation students pointed to the fact that all medical textbooks are written from theory to practice.

**Practical skills**

Students reported they felt well prepared by the skills training in the Skillslab. They had mastered detailed physical examination skills, with which they felt comfortable. They indicated having problems recognising pathology, but expected to learn these skills in practice. At least they had seen and experienced the 'normal' findings and therefore they expected to be able to recognize pathology as 'not normal'.

Furthermore, they mentioned that they had not been trained to perform a short overall examination using integrated skills, as is needed for patient records. Students did not agree among themselves on the necessity of learning these skills prior to their clerkship.

"I did not feel capable of doing a short physical examination and I think we should have been trained in doing an all-round examination before entering the clerkship period". (FV3)

"I wonder whether we would have learned such skills in the first years; I think one learns these skills much quicker by practising with patients". (MV3)

Students agreed unanimously that they were hardly ever observed by clinicians or other health care workers when they examined a patient. When in doubt, they could ask a resident or fellow to verify their findings. They expressed a firm wish to be observed more often and to receive feedback on their physical examination skills

### Learning

The amount of time students studied outside of working hours diverged widely. According to the students, this depends on the individual student, the clerkship and the supervisors. In some clerkships students could study during the day, but most students had to study in the evenings and during weekends.

The way students study in the clerkships differs from that in the pre-clinical years. Students reported they had learned more superficially during the first four years. They had prepared more for recognition in order to pass the assessment. They indicated that they focused on facts, which maximised their chances of passing the test at the end of each unit. Moreover, most tests were of the true/false format and had reinforced this method of preparation. In the clinical years students study more intensively, partly out of curiosity and intrinsic motivation, partly aimed at reproduction in the clinical examination at the end of the rotation. Learning objectives are primarily based on patient problems encountered. As one student said:

> "I learn more case-based, from the patient's complaints. Other issues are important and I learn because I need the knowledge to help the patient". (HS2)

The unanimity of students' comments about the importance of contacts with real patients was striking. Students indicated that knowledge is assimilated much better when linked to a real patient. Learning objectives were easy to formulate in practice, easier than for paper cases. Students felt they now studied more for themselves. Patient problems are problems of real people, which is much more motivating, they said. Typical remarks were:

> "It strikes me that it is very easy to draw up learning objectives now I am in practice, while I found it so hard in the first years. Nowadays I have a list of things I want to look up, so many I lack the time to study them all". (PV3)
>
> "I would like to look up so many things. Now I remember things much better, I should have more time for studying". (HJ1)
>
> "It is much better to have more practice in pre-clinical education. For instance, I seem to remember as if it were only yesterday, whenever a real-life situation was used in a lecture (for example the mum telling about her child with Down's syndrome)". (MV1)

## Discussion and conclusions

This study explored students' perceptions about the transition from theory to practice within the undergraduate medical curriculum. In general, students considered themselves well prepared for clinical practice, which is in line with other findings.[10, 15] They express general satisfaction with their pre-clinical preparation and not many students report major problems concerning the transition to clinical practice. Negative experiences are associated with professional socialisation and difficulties in the application of knowledge and skills. Students also find themselves using a different learning strategy, i.e. from practice to theory whereas is used to be the other way around.

The problems related to professional socialisation concern the long working hours and the time and energy students have to expend in adapting to their new environment, which may explain the crisis in students' learning progress at the start of clerkships that is reported in the literature.

The difficulties in the application of knowledge and skills appear to be related to the curriculum. Students reported good preparation for clinical skills, which is in line with earlier studies.[10, 15] The reported easy contact with real patients and the mastery of physical examination skills may be due to the comprehensive Skillslab training sessions, which provided many simulated patient contacts. Students report more deficiencies in knowledge than in clinical skills. It is not surprising that students are unsure in recognising pathology, as they see few real patients and pathology in the first four years. The clerkships should provide them with the opportunity to learn this. From this perspective, there is every reason for concern when students say that they are hardly ever observed or supervised and that feedback is rarely given. How do we expect them to learn?

Students discover deficiencies in knowledge of basic sciences during clerkship. They regret having paid too little attention to anatomy and pharmacology in the pre-clinical years. Contrary to expectations, PBL apparently fails to bring about the integration of basic and applied sciences, which it is supposed to enhance. McMaster graduates, who followed a comparable problem-based curriculum, also reported that anatomy and pharmacology were two content areas requiring more attention.[7] More research is needed to examine the reported deficit in students' knowledge of basic sciences.

An interesting finding is that students say that they learned from 'theory to practice' in their first years. PBL is supposed to enhance clinical reasoning skills and PBL students are assumed to reason from clinical information to theory from the very start of medical school. The results of our study suggest that the reverse is true. In spite of the PBL system, students learn which symptoms are associated with a specific diagnosis. The students say that it is a new experience to be confronted with a combination of symptoms and having to formulate a differential diagnosis on the basis of them. Student learning in the clerkships appears to be driven by curiosity and exploration. They want to understand the patient problem. By contrast, they perceive their learning during the pre-clinical years as passive acquisition of knowledge, despite the problem-based system. This finding is not congruent with the literature stating that PBL enhances intrinsic interest and self-directed learning skills.[16]

Our findings may be attributable to the way PBL is implemented in the present curriculum. We found indications that students adapted their learning strategy to the assessment programme. These results are in line with findings that assessment plays a dominant role in student learning.[17] A reasonable conclusion would be that the Maastricht assessment system is not congruent with the PBL educational programme. Another explanation might be that students work with paper cases in the first four years and see hardly any real patients before the clerkships. From students' comments about their contacts with real patients the conclusion can be drawn that patient contact makes the course seem 'real' and provides motivation. This is in line with results reported by Briggs-Style et al. and Van de Wiel et al..[18, 19] It follows from this that early patient contacts, in addition to simulated-patient contacts, could add enjoyment and motivation to the early years of medical school and help students learn more effectively.

The qualitative data gathered in this study were based on the views of 20 students. This sample is small and not all problems may have been covered. However, the students who participated were representative of the total group with respect to the male/female ratio and progress test results. When asked, students declared that each group's opinion corresponds to what they hear from other students. Given that the results of the three groups correspond for most topics, we are confident that we have obtained representative information. Based on this information we have started a quantitative study to confirm the results from this focus group study.
The following recommendations for optimising students' learning can be derived from the findings in our study: adapting the assessment system to the educational programme, teaching students and tutors how to better use the educational system, and introducing early patient contacts. The gap between theory and practice could be narrowed by offering more practical experiences in the pre-clinical phase and some problem-based tutorials in the clinical phase.

Finally, although students appear to be generally satisfied with their pre-clinical education, there is evidence that the transition from the theoretical phase to the clinical phase is a big step. One of the major goals of PBL, to prepare students for real clinical practice, appears to be only partially achieved. In comparison with graduates from two traditional medical schools, graduates from a PBL-school rated their undergraduate preparation more highly.[15] This suggests that the transition may pose even greater difficulties to students in a traditional school. Because these problems may disrupt the learning process and cause inefficient use of clerkship time, further research is needed to confirm these results. Smoothing the transition should be a challenge to educators and clinicians.

Note
(XXY) indicates the student's initials and group number where the remark was made.

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# Kennis

Wat mij qua kennis opviel is dat we veel zaken andersom geleerd hadden. Je leert bijvoorbeeld dat bij een hartinfarct deze klachten en deze symptomen horen. In de kliniek zie je een patiënt met bepaalde symptomen en dan krijg ik het andersom niet voor elkaar. Als ik een patiënt zie met deze en deze klacht en deze bloeduitslagen dan kan ik niet terug redeneren naar de ziekte. Het probleem daarbij is dat het heel moeilijk te vinden is (vanuit een probleem), het staat altijd andersom in de boeken. Het stomme is dat de diagnose vaak het leerdoel was en niet bijvoorbeeld: Waarom heeft deze patiënt een verhoogd gamma GT?

(citaat focusgroep onderzoek)

# 3
# Students' opinions about their preparation for clinical practice

Published as: Prince KJAH, Boshuizen HPA, Van der Vleuten CPM, Scherpbier AJJA. Students' opinions about their preparation for clinical practice. Medical Education 2005; 39: 704-12

## Abstract

There are data that suggest that medical students do not feel sufficiently prepared for clinical practice in the clerkships. The transition from pre-clinical to clinical training causes problems.

The purpose of this study was to seek quantitative verification of qualitative findings from an earlier focus group study on problems medical students encounter when entering the clinical phase of undergraduate training.

At the start of the clinical phase, all Year 4 students at Maastricht Medical School were surveyed on the transition from pre-clinical to clinical training and its effects on workload, knowledge, skills and learning.

The response rate was 67%. Students were uncertain as to how to behave and act, mainly because they did not know what was expected of them. They experienced a drastic increase in workload and a lack of time for studying. They considered themselves to be moderately prepared with regard to knowledge and they regarded their physical examination skills as satisfactory. Students reported having difficulty applying theoretical knowledge in clinical practice and perceived shortcomings in basic science knowledge. In addition, they felt compelled to change their learning strategy.

The results of this study confirm the findings of the focus group study. The students experienced problems related to professional socialisation and workload and deficiencies in knowledge and the organisation of knowledge. A good starting point for improvement may involve exploring students' suggestions of an extensive introduction into the clerkships, a more gradual transition with regard to workload and closer integration of pre-clinical and clinical education.

## Introduction

Although pre-clinical medical education is supposed to prepare students for clinical education, there are signs that medical schools are not entirely successful in this respect. Interviews by Radcliffe and Lester with final year medical students showed that transition periods were prime causes of stress.[1] The most frequently mentioned stressful transition concerned that from pre-clinical science student to apprentice doctor on the ward. Causes of stress included changes in learning environment, teaching styles and expectations. Students described 'feeling useless, unable to contribute to patient care because they had insufficient knowledge or skills'.[1] Alexander and Haldane also highlighted the transition from pre-clinical to clinical education as a particularly stressful period.[2] As causes of stress final year students mentioned the impending transition from a highly dependent learner role to one entailing at least delegated responsibility and decision making, and the need to work with other professional groups.[2] Another study showed that a quarter of final year students had difficulty making the transition from pre-clinical studies to clinical work.[3] Firth found that talking to psychiatric patients caused the greatest reported stress among students, and that presenting cases, effect on personal life, and dealing with death and suffering also led to perceived stress.[4] Relationships with consultants aroused strong feelings, which was evidenced by some stressful situations described by students, such as being humiliated in front of their peers. Moss and McManus found that students were anxious about performing tasks on patients and perceived relationships with senior staff to be anxiety-inducing.[5]

The use of more authentic, integrated tasks, in which knowledge and application of knowledge are learned together, has been proposed as a way to make the pre-clinical-clinical transition less problematic. Problem-based learning (PBL) is said to offer such tasks. Norman en Schmidt concluded that 'PBL promotes the transfer of concepts to new problems, the integration of basic science concepts into clinical problems, intrinsic interest in subject matter and self-directed learning skills.'[6] If these claims are substantiated, PBL students should be able to transfer from pre-clinical to clinical training with relative ease.

Most recommended measures to ease the stress of the transition focus on the pre-clinical phase. However, we might also direct our efforts at the clinical side of the divide. Remmen et al. showed that clinical clerkships do not automatically provide the perfect learning environment for medical students because educational resources are not used optimally, most of the teaching is provided by junior doctors and passive experiences abound.[7] Students frequently indicated that coaching, feedback and supervision were suboptimal. In a study by Lubitz and Nguyen, the prevalence of reported abuse (verbal, physical, sexual and academic) among students in their clinical rotations was high (93.7%) and had a negative impact on both student ability to function and their desire to remain at the medical centre for residency training.[8]

A focus group study by the authors of the present article showed that changes perceived by students at the beginning of the clinical clerkships included

negative experiences associated with professional socialisation, difficulties in applying their knowledge and skills to real patient problems, and the need to adopt different learning strategies.[9] We will describe these three problem areas briefly.

Professional socialisation entails gradual assimilation of the values and attitudes of the medical profession. The need to display accepted forms of professional conduct becomes suddenly much more urgent when students enter the clinical phase. Students have to adjust to long working hours and to a new and very different environment.[9] On top of that they are uncertain about what is expected of them. These socialisation factors may explain the crisis in students' learning that Boshuizen identified as among the symptoms of the 'shock of practice'.[10]

Concerning knowledge and skills, students discovered that they did not always meet the demands of clinical practice. Several studies have shown that graduates from a PBL medical school were well prepared as regards psychosocial and interpersonal skills.[11,12] As for the application of knowledge, in a PBL curriculum students are supposed to learn to use clinical data to reason their way to diagnosis from the start of medical school. However, the students in our focus group study found that clerkship presented them with an entirely new situation. Their knowledge was organised around symptoms associated with particular diseases, but they now had to make a diagnosis on the basis of the signs and symptoms presented by a real patient. To put it briefly, although the students were able to list the symptoms of many diseases, they were unable to generate a diagnosis when a patient presented with symptoms and complaints. Because their knowledge was built around concepts of disease rather than key features, and therefore not tailored to clinical practice, they found themselves forced to change their learning style in the clerkships. This is contrary to what might be expected in a PBL curriculum, which is said to foster understanding rather than the reproduction of facts.[13]

The purpose of the present study was to seek quantitative verification of the qualitative findings from our focus group study on students' perceptions of the gap between pre-clinical and clinical training. To this end we surveyed clerks shortly after their first clinical experiences.

## Methods

### Subjects

Subjects were students at Maastricht Medical School, the Netherlands, who had recently begun their clerkship rotations. The Maastricht undergraduate curriculum offers 4 years of theory-oriented, pre-clinical training and 2 years of clinical clerkships. It aims to bridge the gap between theory and clinical practice by a PBL curriculum with clinical skills training in Skillslab throughout the pre-clinical phase. Clerkships begin at the end of Year 4 in the departments of surgery, internal medicine and psychiatry or with an elective.

Because we were interested in the curricular effect on the transition from classroom to clinical practice, we only included in the study students on

rotations in clinical departments for whom this was the first transition in undergraduate medical education. This meant excluding students with a medical degree from another country or a degree in health sciences, because their earlier experience of a similar transition was expected to affect their current perceptions.

### Questionnaire

We designed a written survey on the five categories of transition-related problems identified in the focus group study: professional socialisation; workload; patient contact; knowledge, knowledge application and skills; learning and education. The questionnaire explored students' recent experiences as 'new' clerks in those areas. The comments of five senior students on clarity and readability were incorporated into the final questionnaire, which contained 95 items and took approximately 20 minutes to complete according to the students in the pilot. Eight items concerned background characteristics, such as age, gender, previous education and earlier patient contacts. The other 77 items consisted of statements to be answered on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Ten open questions asked students to describe what they saw as the 'most relevant' and 'least relevant' components of their education in terms of preparation for clinical practice, their three most salient impressions during the clerkships and suggestions for improvements. The questionnaire was designed and administered in Dutch. For this chapter the questionnaire was translated from Dutch to English.

### Procedure

We obtained a mailing list from the dean's office of all the students whose first clerkship rotation was scheduled in 1998 (n=126). Out of these 126 students, twenty were not doing a clerkship at the time of the survey. The remaining 106 participants received a questionnaire together with a letter explaining the purpose of the study and a reply-paid envelope. We tried to maximise the response by sending out a reminder letter and a telephoning non-responders after two and four weeks, respectively. To enable monitoring of the response, the questionnaires had unique identity codes. The codes were removed before data entry, so that participants' names and individual responses could not be linked to the results.

### Data analysis

We calculated descriptive statistics, including proportions, means and standard deviations. Time was expressed as the median number of hours and 25th and 75th percentiles. The differences between the three clerkships in numbers of hours were analysed with the Kruskal-Wallis test. One-way ANOVA was used to analyse other differences between the clerkships.

## Results

The response rate was 67% (71 out of 106). The gender distribution (29.6% male) in the study population reflected that in the cohort. The participants' mean age was 23.1 years (SD=1.52; range 21-28 years) and the average duration of clerkship at the time of the survey was eight weeks (range 1-14). The students were evenly distributed across the departments (23 psychiatry,

24 internal medicine and 24 surgery).

Table 1: Transition and professional socialisation.

| | Mean score | SD | Disagree % | Neutral % | Agree % |
|---|---|---|---|---|---|
| I was nervous at the beginning of the clerkships | 3.2 | 1.3 | 39.4 | 14.1 | 46.5 |
| I felt ready to begin clinical training | 3.9 | 1.1 | 11.3 | 19.7 | 69.0 |
| The transition from pre-clinical to clinical training went smoothly | 3.3 | 1.2 | 31.0 | 15.5 | 53.6 |
| I felt well prepared for clinical training | 2.6 | 1.0 | 53.5 | 22.5 | 23.9 |
| I have considered quitting medical school | 1.6 | 1.2 | 83.1 | 5.6 | 11.2 |
| I was very uncertain | 3.5 | 1.2 | 22.5 | 19.7 | 57.7 |
| My uncertainty lasted only a few days | 3.6 | 1.2 | 21.1 | 15.5 | 63.3 |
| I needed time to adjust to the new environment | 3.7 | 1.1 | 15.5 | 16.9 | 67.6 |
| I enjoyed the first few weeks | 3.9 | 1.3 | 14.7 | 10.3 | 75.0 |
| I experienced an abrupt transition from preclinical to clinical training | 3.0 | 1.4 | 48.6 | 11.4 | 40.0 |
| I experienced a great deal of stress | 2.6 | 1.2 | 60.6 | 12.7 | 26.8 |
| My first clerkship proved to be better than I expected | 4.0 | 1.0 | 4.2 | 23.9 | 71.8 |
| The first few weeks as a clinical clerk were difficult for me | 3.1 | 1.1 | 38.0 | 16.9 | 45.1 |
| Collaboration with my fellow clerks was easy | 4.4 | 0.7 | 0.0 | 13.2 | 86.7 |
| The clinical staff were easy to work with | 4.3 | 0.7 | 2.9 | 7.1 | 90.0 |
| This was the first time I experienced what it is like to work as a doctor | 3.0 | 1.2 | 40.8 | 22.5 | 36.7 |
| The introduction into the clerkships was satisfactory | 3.2 | 1.3 | 33.8 | 18.3 | 47.9 |
| A good introduction would make the transition easier | 4.5 | 0.7 | 1.4 | 5.6 | 92.9 |
| A general introduction should be provided to all new clinical clerks | 3.8 | 1.3 | 16.9 | 19.7 | 63.4 |

Mean scores (1=strongly disagree; 5=strongly agree) and the percentages of the students (N=71) who disagreed (scores 1 and 2), were neutral (score 3) or agreed (scores 4 and 5).

## Transition and professional socialisation

Although almost half of the students were nervous at the start of clerkship, most students reported being mentally ready for this phase (Table 1). Half of the students did not feel well prepared and 40% agreed that the transition was abrupt. Of the students, 11.2% indicated that they had considered leaving medical school at the start of clerkship. They had difficulty adjusting to the

daily routine. Clerkship was better than expected for 71.8% of the students and 36.7% indicated that they experienced for the first time what it was like to be a doctor. Agreement was overwhelming concerning the positive effect of a good introduction and substantial with respect to the desirability of a general introduction. Less than half of the students thought the current introduction was satisfactory.

### Workload

The number of hours of clinical work was lower in psychiatry (median = 40 hours, interquartile range 25-75% = 35-40 hours) compared with internal medicine (median = 50 hours, interquartile range = 45-50 hours) and surgery (median = 50 hours, interquartile range = 45-53.75 hours) (P<0.001). The number of hours for independent study showed a descending order from psychiatry to internal medicine and surgery (5, 3, and 1.5 hours of self-study respectively) (P=0.002) (Table 2).

Approximately half of the students thought the hours long, the workload heavy and the work tiring. Nearly three quarters of the students perceived a huge change in workload and thought they had insufficient time for studying.

Table 2: Workload.

| | Mean score | SD | Disagree | Neutral | Agree |
|---|---|---|---|---|---|
| | | | % | % | % |
| As a clinical clerk I have to work very long hours. | 3.3 | 1.2 | 29.0 | 18.8 | 52.1 |
| The workload of clinical clerks is heavy | 3.3 | 1.3 | 33.8 | 18.3 | 47.9 |
| I had difficulty getting used to the work routine | 3.0 | 1.3 | 39.4 | 22.5 | 38.1 |
| So far clerkships have been tiring | 3.2 | 1.3 | 32.4 | 19.7 | 47.9 |
| There is a huge difference between my workload before and after the transition to clinical training. | 3.9 | 1.1 | 14.3 | 14.3 | 71.4 |
| As a clinical clerk I have enough time to study. | 2.3 | 1.2 | 71.4 | 8.6 | 20.0 |

Mean scores (1=strongly disagree; 5=strongly agree) and the percentages of the students (N=71) who disagreed (score 1 and 2), were neutral (score 3) or agreed (score 4 and 5).

## Patient contact

For the majority of the students, patient contacts posed no problems and had a favourable effect on their learning (Table 3).

Table 3: Patient contact.

| | Mean score | SD | Disagree | Neutral | Agree |
|---|---|---|---|---|---|
| | | | % | % | % |
| Contact with real patients is easy for me. | 4.3 | 0.7 | 1.4 | 9.9 | 88.8 |
| Contact with real patients stimulates me to study | 4.2 | 0.8 | 2.8 | 14.1 | 83.1 |
| The knowledge that I acquire from contact with real patients is easier to retain | 4.5 | 0.8 | 2.8 | 8.5 | 88.8 |
| I would have liked real patient contact earlier in the curriculum | 4.0 | 1.1 | 12.7 | 16.9 | 70.5 |
| I am afraid to start a conversation with a patient | 1.9 | 1.0 | 77.5 | 14.1 | 8.4 |
| I feel uncomfortable when I examine a patient | 1.8 | 0.9 | 81.7 | 11.3 | 7.0 |
| I think patients feel uncomfortable when they are examined by a student | 2.3 | 1.0 | 64.8 | 19.7 | 15.5 |
| My first contact with real patients was during the clinical clerkships | 2.0 | 1.3 | 74.6 | 5.6 | 19.7 |

Mean scores (1=strongly disagree; 5=strongly agree) and the percentages of the students (N=71) who disagreed (score 1 and 2), were neutral (score 3) or agreed (score 4 and 5).

## Knowledge, application of knowledge, and skills

The majority of the clerks perceived gaps in their knowledge and half of them did not have the appropriate knowledge readily available (Table 4). More than half of the students agreed that clinical practice called for a different type of knowledge than they had acquired during preclinical training. Some students volunteered that assessment in the preclinical phase had stimulated them to study for recognition rather than understanding. Agreement on knowledge being sufficient was expressed by half of the students for the behavioural science domain and by 25.4% and 18.5% for the domains of clinical science and basic science, respectively. Knowledge deficiencies were mostly perceived in anatomy and pharmacology (27 and 16 students, respectively).

As for clinical skills (Table 4), the majority of students felt themselves well prepared and able to perform them. However, 43% had difficulty recognising symptoms and only a quarter felt confident about the findings from history and physical examination. Almost one third of the students indicated that their findings were not checked by supervisors.

Table 4: Knowledge and skills.

| | Mean Score | SD | Disagree | Neutral | Agree |
|---|---|---|---|---|---|
| | | | % | % | % |
| I was sufficiently prepared for the clerkships as regards theoretical knowledge | 2.8 | 1.1 | 45.7 | 22.9 | 31.4 |
| The knowledge I acquired during the preclinical phase is relevant for the clinical phase | 4.1 | 0.7 | 1.4 | 12.9 | 85.7 |
| The level of my knowledge is sufficient | 2.6 | 1.1 | 48.6 | 28.6 | 22.9 |
| I am able to apply my knowledge in practice | 3.6 | 0.8 | 14.3 | 22.9 | 62.9 |
| I have the appropriate knowledge readily available | 2.7 | 1.0 | 50.7 | 25.4 | 23.9 |
| The knowledge required in clinical practice is different from my theoretical knowledge | 3.5 | 0.9 | 19.7 | 18.3 | 61.9 |
| I have sufficient basic science knowledge | 2.6 | 0.9 | 47.1 | 34.3 | 18.5 |
| I have sufficient clinical science knowledge | 2.8 | 0.9 | 36.6 | 38.0 | 25.4 |
| I have sufficient behavioural science knowledge | 3.4 | 1.0 | 21.1 | 28.2 | 50.7 |
| There are gaps in my knowledge | 4.3 | 0.8 | 4.2 | 7.0 | 88.7 |
| In clinical practice other aspects of knowledge are important than during preclinical training | 3.7 | 1.0 | 14.3 | 24.3 | 61.5 |
| I felt well prepared for clinical skill performance | 3.9 | 1.0 | 8.6 | 17.1 | 74.3 |
| I am able to do a physical examination | 4.0 | 0.8 | 4.3 | 15.9 | 79.7 |
| I felt well prepared to perform medical technical skills | 3.8 | 1.0 | 8.7 | 23.2 | 68.1 |
| I felt well prepared with respect to communication skills | 4.4 | 0.6 | 0.0 | 4.3 | 95.6 |
| I am able to take a history | 4.0 | 0.9 | 5.8 | 14.5 | 79.7 |
| I am able to do a full physical examination | 3.6 | 1.0 | 11.9 | 20.9 | 67.1 |
| I have difficulty recognising pathological symptoms | 3.2 | 1.0 | 27.5 | 29.0 | 43.5 |
| I feel confident about the findings from history and physical examination | 2.8 | 0.9 | 39.1 | 34.8 | 26.1 |
| When I do a history and physical examination the findings are checked by clinical staff | 3.1 | 1.3 | 31.3 | 26.9 | 41.8 |

Mean scores (1=strongly disagree; 5=strongly agree) and the percentages of the students (N=71) who disagreed (score 1 and 2), were neutral (score 3) or agreed (score 4 and 5).

## Learning and education

Table 5 shows that the majority of the students felt capable of studying independently, found what they learned in clinical practice easy to retain, and studied because they were interested in a subject. Assessment guided the learning of little over one third of the students. One of the results of clerkship was that most students studied in a different way and 64.8% of the students said they studied more intensively.

Table 5: Learning and education.

| | Mean Score | SD | Disagree | Neutral | Agree |
|---|---|---|---|---|---|
| | | | % | % | % |
| I am able to study independently | 4.4 | 0.8 | 2.9 | 8.6 | 88.6 |
| It is easy for me to obtain experiences from which I can learn. | 3.9 | 1.0 | 11.3 | 14.1 | 74.7 |
| I study to learn the things that I want to know | 4.2 | 0.9 | 5.6 | 15.5 | 78.9 |
| What I study is influenced by the assessment programme. | 2.9 | 1.3 | 35.7 | 27.1 | 37.1 |
| In clinical practice I study in a different way | 4.4 | 0.6 | 0.0 | 7.0 | 93.0 |
| I study in a different way than during my first years in medical school. | 3.6 | 1.2 | 22.5 | 25.4 | 52.1 |
| I study primarily for tests and examinations | 2.4 | 1.0 | 57.7 | 26.8 | 15.5 |
| My learning is driven by questions from clinical staff | 3.6 | 1.0 | 14.1 | 21.1 | 64.8 |
| I study more intensively than before the clerkships | 3.6 | 1.1 | 18.3 | 16.9 | 64.8 |
| I am able to judge my own progress | 3.7 | 1.0 | 12.7 | 23.9 | 63.4 |
| The knowledge I acquire in clinical practice is easier to remember | 4.4 | 0.7 | 1.4 | 2.9 | 95.7 |
| What I study depends on the problems I have encountered that day. | 4.3 | 0.8 | 1.4 | 12.9 | 85.7 |
| I need to study because I have forgotten a good deal of my theoretical knowledge | 4.1 | 0.8 | 2.9 | 15.9 | 81.2 |
| The first years in medical school were relevant for clinical practice. | 4.0 | 0.8 | 7.0 | 9.9 | 83.1 |
| PBL provided good preparation for clinical practice | 3.9 | 0.9 | 8.6 | 15.7 | 75.7 |
| I learned a lot from simulated patient contacts | 3.8 | 1.0 | 11.4 | 17.1 | 71.4 |
| Simulated patient contacts were good preparation for contact with real patients. | 3.7 | 1.0 | 8.5 | 25.4 | 66.2 |
| I learned a lot from real patient tutorials | 3.5 | 1.1 | 19.7 | 23.9 | 56.3 |
| Real patient tutorials were good preparation for the clerkships | 2.9 | 1.1 | 32.4 | 35.2 | 32.4 |
| I learned a lot from the tutorial meetings in which the simulated patient contacts were discussed. | 2.6 | 1.1 | 47.9 | 33.8 | 18.3 |
| You can learn a lot from bedside teaching | | 4.2 | 0.7 | 0.0 | 17.6 |
| You can learn a lot from the handover of patients. | 3.2 | 1.1 | 23.5 | 32.4 | 44.1 |
| Junior staff are good teachers | 3.7 | 0.9 | 10.0 | 20.0 | 70.0 |
| Senior staff are good teachers | 3.2 | 1.1 | 20.0 | 37.1 | 42.9 |

Mean scores (1=strongly disagree; 5=strongly agree) and the percentages of the students (N=71) who disagreed (score 1 and 2), were neutral (score 3) or agreed (score 4 and 5).

A large majority agreed that preclinical training had been relevant and that PBL had been a good preparation for clinical practice. Simulated patient (SP) contacts were thought to be good preparation by over half of the students, although fewer students appreciated the discussion of the contacts afterwards. Bedside teaching was seen as a good learning experience by many students, but fewer than half of them regarded the patient handover at

the end of the day as such. Junior doctors and senior doctors were regarded as good teachers by 70% and 42.9% of the students, respectively.

### Open questions

More than half of the students wanted more information about what was expected of them as clerks, their role and their responsibilities. They wanted to learn how to admit patients, particularly how to do a quick, structured, physical examination.

The top 3 'most relevant' aspects of preclinical preparation for clinical practice were skills training (n=38), clinical tutorials with real patients (n=19) and simulated patient contacts (n=17). The 'least relevant' were the discussions of the simulated patient contacts (n=28).

The most salient early clerkship impressions fell into seven categories (in order of frequency):
1. workload (increased);
2. patient contact (highly valued);
3. learning (more and faster in clinical practice);
4. contact with colleagues (very positive and very negative statements about staff and staff-student contact);
5. knowledge (lack of);
6. new environment (hospital hierarchy);
7. the content of the profession of a medical doctor.

Suggestions for improvement concerned:
1. more study time, with some students recommending more dedicated time during rotations for studying and formal educational activities, such as tutorial groups;
2. earlier patient contact to facilitate knowledge acquisition, and
3. a better introduction to the clerkships to make the transition from theory to practice less stressful.

## Discussion

We sought quantitative verification of qualitative data on students' experiences on entering the clinical clerkships regarding professional socialisation, application of knowledge and learning behaviour by a questionnaire survey of fourth year students.

The response rate of 67% is reasonable for a written survey. Although reliability may be compromised when results are based on subjective information, the similarity between the responses to the Likert type items and the open questions and the fact that the findings confirm those of the qualitative study appear to support the reliability of the results. Other limitations, such as over-reporting bias and students' inability to make comparisons with other curricula, are inevitable in this type of study.

Contrary to our expectations, the problems encountered by the Maastricht PBL students were similar to those reported by students in traditional curricula: a sudden increase in workload, insufficient time for studying, difficulty putting theory into practice, perceived shortcomings in basic science knowledge,

and the necessity to adopt different learning strategies.

### Workload

Although the tendency to overestimate the amount of time spent on certain activities may have inflated the reported workload, the fact that the number of hours reported by the clerks was at least twice that reported for study-related activities in a preclinical module suggests a substantial increase in workload.[15] Although only a minority of the students thought that their workload was too heavy, it is worrisome that students reported having insufficient time for studying.

### Knowledge, application of knowledge and skills

As in the focus group study, most students experienced deficiencies, especially in basic science knowledge. This suggests that the present study offers no vindication of Dolmans and Schmidt's contention that basic and clinical science are better integrated in a PBL curriculum.[16] Graduates of the PBL curriculum of McMaster University, Canada also reported knowledge deficiencies in basic science, particularly in anatomy and pharmacology.[17] Students felt able to perform a history and physical examination, but were insecure about how to interpret the findings. This implies that diagnosis, management plan and treatment pose problems. Regehr and Norman also found that students' ability to recite the appropriate signs of a given disease did not guarantee their ability to recognise that disease when a patient presented with symptoms in a clinical setting.[18] They showed that students and experts obtained useful diagnostic information from visual signs, but that data interpretation was difficult.[18] Educational approaches might benefit from re-evaluation of the importance of these components of clinical skills.

### Learning and education

The results suggest that the students switched to more intrinsically motivated learning during clerkship. Apparently, the Maastricht preclinical curriculum fails to live up to the claims that PBL fosters this type of learning during the preclinical phase as well. Remarks made by the students suggest that the assessment programme may play a role by reinforcing rote learning. Assessment at Maastricht comprises end-of-module tests, progress tests and objective structured clinical examinations (OSCEs).[19] The progress test is designed to promote learning aimed at understanding.[20] However, when used summatively, it may not challenge students to self-responsible, free and interest-based learning.[21]

The students said that patient cases facilitated the acquisition and retention of knowledge. Real patient contacts appear to increase the motivation to learn and promote the acquisition of knowledge that can be used in daily practice. The students felt well prepared for patient contacts by their preclinical training.

### Recommendations for improvement

Students suggested adjustments on either side of the 'preclinical-clinical divide'. These included contact with real patients in the preclinical phase and structured educational activities, such as tutorial groups, and dedicated time for studying in the clinical phase. Students also suggested that a better

way of introducing them to the clerkships could be developed.

## Conclusions

The results of this quantitative study support our earlier qualitative findings regarding the transition from preclinical to clinical training. Apparently, PBL is not a panacea for the problems associated with this transition, although this may be attributable to the way it is implemented in Maastricht. Nevertheless, it is encouraging that students indicated that the PBL curriculum offered good preparation for clinical skill performance and moderate preparation as regards knowledge.

It is inevitable that students should have to adjust to 'cultural differences' between the classroom and the clinical setting. However, we believe that as educators we should not shirk our responsibilities and accept an unsatisfactory situation that stifles students' progress. The present study confirms the urgency of the transition problem by providing quantitative confirmation of our earlier qualitative findings. Efforts to bridge the preclinical-clinical divide may start by careful consideration of students' recommendations, such as an extensive introduction at the beginning of the clerkship phase, a more gradual transition with regard to workload and better integration of the preclinical and clinical phase, all of which are consistent with suggestions from the literature.[22, 23]

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# Patiënt en ziekte

Ik vind het grootste verschil dat je in het begin van de opleiding niet weet wat voor gevolgen een ziekte voor de persoon zelf heeft. Stel het gaat over chronische hepatitis, dan weet je precies hoe dat zit in de lever, welke titers stijgen en wanneer ze dalen. Maar je weet niet wat dat betekent voor de patiënt zelf. Wij leren het allemaal zo netjes uit de boeken en daar staat een klein stukje over de prognose in. Maar in de praktijk zie je mensen die iets hebben en realiseer je je wat dat voor gevolgen heeft voor die persoon. De keren dat een patiënt iets kwam vertellen bij een college staan mij nog bij alsof ik het gisteren heb gehoord.

(citaat focusgroep onderzoek)

# 4
# Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy

Published as: Prince KJAH, Van Mameren H, Hylkema N, Drukker, Scherpbier AJJA, Van der Vleuten CPM. Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy. Medical Education 2003; 37: 15-21.

## Abstract

Problem-based learning (PBL) is supposed to enhance the integration of basic and clinical sciences. In a non-integrative curriculum, these disciplines are generally taught in separate courses. PBL students perceive deficiencies in their knowledge of basic sciences, particularly in important areas such as anatomy. Outcome studies on PBL show controversial results, sometimes indicating that medical students at PBL schools have less knowledge of basic sciences than do their colleagues at more traditional medical schools. We aimed to identify differences between PBL- and non-PBL-students in perceived and actual levels of anatomy knowledge.

Samples of Year 4 students in all eight medical schools in the Netherlands completed a questionnaire on perceived knowledge and took part in a computerised anatomy test consisting of both clinically contextualised items and items without context.

PBL students were found to have the same perceived level of anatomy knowledge as students at other medical schools. Differences in actual levels of knowledge were found between schools. No significant effects on knowledge levels were found for PBL-schools versus non-PBL schools.

The results of this study show that PBL does not result in a lower level of anatomy knowledge than more traditional educational approaches. It remains to be ascertained whether the levels students attain are adequate. Subjects for further study are the desired level of anatomy knowledge at the end of undergraduate medical education and the effectiveness of basic science learning within a clinical context and with repetition over the course of the curriculum.

## Introduction

Problem-based learning (PBL) is supposed to enhance the integration of students' knowledge.[1] Students use (clinical) problems as the starting point of the learning process and define their own learning objectives in the tutorial group. These learning objectives reflect basic science disciplines as well as clinical disciplines and both fields are studied concurrently. In technical terms, disciplines in PBL are horizontally and vertically integrated. Because learning takes place in a meaningful and authentic context, such as clinical cases, students learn to connect clinical phenomena to underlying basic science concepts. Evidence from cognitive psychology has shown that integration of knowledge facilitates the storage and later retrieval of relevant information.[2] Integrated knowledge should prepare students better for actual clinical practice.[2]

However, a series of recent studies from the University of Maastricht, which uses a PBL approach, gave rise to concern. In a qualitative study students reported that they felt deficient in basic science knowledge, anatomy in particular, when entering the clerkships.[3] Students claim that the integrated approach to learning, or rather the lack of dedicated courses, causes uncertainty and the perception of being inadequately prepared for clinical practice. Two earlier survey studies showed similar results: in retrospect Maastricht graduates indicated that they had not acquired sufficient knowledge of gross anatomy, and students doing their clinical rotations expressed a need for more anatomy training both before and during clerkships.[4, 5] Graduates of McMaster University also indicated that basic sciences received insufficient attention in the McMaster PBL-curriculum.[6] It is unknown whether students at (more) traditional medical schools experience similar problems. Students in general consider anatomy a very important subject for their future as a practising physician.[7] A number of studies have compared the basic science knowledge of PBL-students and non-PBL students. Any differences in basic science knowledge that are found, are usually in favour of non-PBL students.[8-11] In conclusion, the integrated PBL approach seems to be associated with uncertainty and perceived deficiencies regarding basic science knowledge.
It should be noted that PBL is used to describe many heterogeneous educational activities.[12] The claims made by its advocates are therefore hard to prove or disprove.[13] In order to objectify the deficiencies perceived by PBL students at Maastricht, we investigated whether PBL and non-PBL students in the Netherlands differ in perceived and real knowledge of anatomy at the start of the clinical clerkships.

On the basis of the studies mentioned earlier, clinical anatomy was chosen as the discipline of study. Clinical anatomy is defined as anatomy that is indispensable for a good understanding of the medical physical examination, modern imaging techniques, diagnosis and many invasive and non-invasive procedures. It provides the language of professional communication between physicians. In line with the findings of some of the earlier studies, we expected non-PBL students to show superior knowledge of clinical anatomy. However, given the integrated nature of anatomy learning in PBL, we expected these differences to vanish or even change in favour of the PBL students, when the knowledge of clinical anatomy was assessed in the context of a clinical problem.

The following research questions were formulated:

1. How do PBL and non-PBL students compare in terms of their perceived levels of knowledge of anatomy?
2. How do PBL and non-PBL students compare in terms of performance on an anatomy test consisting of non-contextual fact-oriented items and clinically contextualised items?

A study was conducted in which a questionnaire and computerised anatomy tests were administered to samples of fourth-year medical students from the eight Dutch medical schools.

## Methods

### Subjects

The study population consisted of groups of fourth year students from all eight medical schools in the Netherlands. The study was initiated by the Maastricht medical school (PBL approach). The other schools agreed to participate on condition that the results relating to their school would be reported anonymously. Therefore, the schools are referred to by the letters A through H.

Undergraduate medical education in the Netherlands lasts six years, four years of primarily theoretical education and two years of clerkships. Currently, most medical school curricula in the Netherlands are undergoing extensive revision. At Maastricht (school A) the PBL approach has been used in the first four years of the medical curriculum since the early 1970s. When we conducted this study, schools B through E were not fully problem-based, i.e. there was some degree of horizontal and vertical integration of basic and clinical science and problem orientation. Schools F, G and H had more traditional, lecture-based curricula with hardly any vertical integration.

In the Netherlands students enter medical school directly from high school after they have passed the national final high school examination at the level required for entrance to medical school. Because there are more applicants for medical school than places, a grade weighted lottery system, performed by a national agency, determines admission. Subsequently, the same agency allocates students to the different medical schools. Although it has not been strictly proven so far, it is assumed that there are no systematic differences between the students that enter the different medical schools. Because we wanted to investigate the effects of different medical school programmes on students' knowledge, we included only students who had spent all of the first four years in the same medical school. Moreover, only students who had not started clerkships were included.

All fourth year students of the eight Dutch medical schools (n = 1884) were invited to participate. Due to the limited availability of computers for the test, we restricted the number of participants to approximately 50 students per school, allowing sufficient power for statistical inferences. Students were selected on a first-come-first-served basis and received a small financial compensation. They were given feedback, i.e. they were sent their personal score and the overall national scores on the test.

A total of 424 students participated. Data of seven students were lost due to

computer malfunctioning and six students were excluded because they had already started their clerkships or had attended different schools. Data of 411 students were analysed (22% of all Dutch fourth year medical students).
It is often the better students who volunteer to participate in a study. To establish whether the participating students were representative of their class, we compared their scores on regular in-training examinations, if available, with those of their non-participating fellow students.

**Questionnaire**

All participating students were asked to complete a short questionnaire before taking the anatomy test. This questionnaire contained questions on demographic characteristics such as age, gender and whether or not a student had assisted in anatomy teaching as an instructor. At several schools some students assist at anatomy practicals as so-called student-instructors. We expected these students to perform better on the test due to higher prior knowledge levels, special interest in anatomy, extra training or a combination of these factors. To answer our first research question, students were asked the following two questions about their perceived level of knowledge of anatomy:

1) If the total amount of anatomy knowledge that you could have acquired at this point in the medical curriculum is 100%, how much of that knowledge do you think you have actually mastered?
2) If the total amount of anatomy knowledge you must have mastered upon graduation is 100%, how much of that knowledge do you think you have mastered at this point in the curriculum?

Students could answer both questions in four categories, namely 0-25%, 25-50%, 50-75% and 75-100%.

**Anatomy test**

In order to test anatomical knowledge using items with and without clinical context, two sub-tests were constructed. Firstly, more than 50 clinicians from 18 disciplines were asked to generate topics that students are likely to encounter during clerkships and for which they need anatomical knowledge. On the basis of this list a team of medical practitioners, anatomists and educationalists developed 16 patient cases with 142 accompanying items. Following the rule that the format of the question should match the content and based on the number of realistic alternatives in real life,14 various response formats were used: open ended items, multiple choice items and true/false type items. The test was reviewed by medical practitioners, who checked the quality of the test, especially the accuracy of the description of the patient and the answers. Based on these reviews a few adjustments were made.

The sub-test without clinical context consisted of 50 items from an existing examination, the Maastricht Progress Test.15 16 The items were selected on the basis of the above-mentioned list of topics. All progress test items are of the true/false format and undergo an extensive review process.16 In compiling the two sub-tests, attention was paid to the distribution of items over the various clinical disciplines and the different regions of the human body.

After test administration an item analysis was performed and the items were judged by panels of anatomists and clinicians. Six items (four items with clinical information and two items without clinical information) were removed because they proved to be incorrect or unclear. The final test consisted of 186 items, 138 items with clinical context in 16 cases and 48 items without clinical context. Test administration took approximately two hours. Table 1 shows examples of items from the two sub-tests.

The test was administered by computer. At seven medical schools test administration took place in the spring of 2000. At the remaining school clerkships start earlier, i.e. in the autumn of fourth year. Therefore, the students at that school were tested in the autumn of 2000, immediately before entering the clerkships.

Table 1: Examples of test items.

| |
|---|
| Example of an item with context: |
| The general practitioner (GP) examines the eye movements of Mrs. Ommen. He asks her to look in all directions. Her right eye does not move to the right when she looks in that direction. The GP suspects a paralysis of a specific extra-ocular muscle. Which muscle is involved? |
| Answer: lateral rectus |
| Example of an item without context: |
| The bronchial arteries are branches of the pulmonary arteries. True or false? |
| Answer: false |

## Statistical analysis

To test whether the participating students were representative of their class we calculated z-scores of the results of various regular examinations of participating and non-participating students from the same class. This could only be done for schools where such examination results were available. A t-test was used to compare the mean z-scores of the participating students with those of the non-participating students.

We compared the age and gender distribution between schools, and the number of student-instructors. The results of the questionnaire and the tests were analysed for the student-instructors as a sub-group and for each school, both including and excluding the results of the student-instructors.

Students could answer the two questions in the questionnaire in four categories (0-25%, 25-50%, 50-75% and 75-100%). Differences between schools were analysed using a Kruskal-Wallis test for non-parametric data with Bonferroni correction for multiple comparisons.

The scores on the anatomy tests were calculated as the percentage correct answers. Because of the different numbers of questions across cases in the sub-test with clinical context, scores were calculated per case and averaged. This way all cases contributed equally to the sub-test score.

The reliability of the two sub-tests was calculated as Cronbach's alpha for internal consistency. For the sub-test with clinical context this was calculated over the 16 cases, for the sub-test without context over the 48 items.

One way ANOVA with post-hoc analysis was used to test the significance of the differences between the mean test scores on the anatomy tests of the different schools (alpha .05).

## Results

### Participants

Data of 411 students were analysed. The male-female distribution was similar to that for all medical students in the Netherlands, i.e. 38.4%-61.6%.17 The mean age was 22.7 years (range 21-32 years). There were no significant gender or age differences between the participants from the various schools.
The comparison between the results on the experimental tests and regular exams showed that the participating students from schools A and G were representative of their class, whereas the participating students from schools C, D, E and H were amongst the better students of their class. For the other two schools data of relevant regular exams were not available.

Of the 411 students 55 had assisted in anatomy teaching as student-instructors. Their levels of perceived knowledge were higher and they performed much better than the other students. Since the number of student instructors differed between schools and the differences between schools did not change when they were left out of the analysis, only the results of the regular students are presented in this paper.

Table 2: Perceived knowledge (student-instructors omitted) by medical school (A-H).

| | | Perceived knowledge at the end of year 4 as percentage of : | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Knowledge that could have been acquired at the end of year 4 (Question 1) | | | | Knowledge required at the end of year 6 (Question 2) | | | |
| Schools | N | 0-25 | 25-50 | 50-75 | 75-100 | 0-25 | 25-50 | 50-75 | 75-100 |
| A | 75 | 10.8 | 47.3 | 39.2 | 2.7 | 17.3 | 49.3 | 30.7 | 2.7 |
| B | 46 | 8.7 | 52.2 | 34.8 | 4.3 | 23.9 | 39.1 | 28.3 | 8.7 |
| C | 36 | 13.9 | 58.3 | 27.8 | 0.0 | 27.8 | 41.7 | 22.2 | 8.3 |
| D | 47 | 10.6 | 55.3 | 29.8 | 4.3 | 34.0 | 55.3 | 10.6 | 0.0 |
| E | 32 | 3.1 | 59.4 | 34.4 | 3.1 | 21.9 | 37.5 | 37.5 | 3.1 |
| F | 33 | 12.1 | 63.6 | 24.2 | 0.0 | 15.2 | 54.5 | 27.3 | 3.0 |
| G | 38 | 7.9 | 44.7 | 47.4 | 0.0 | 7.9 | 28.9 | 55.3 | 7.9 |
| H | 49 | 8.2 | 32.7 | 57.1 | 2.0 | 8.2 | 53.1 | 28.6 | 10.2 |
| Total | 356 | 9.6 | 50.4 | 37.7 | 2.3 | 19.4 | 45.8 | 29.5 | 5.3 |

Question 1: only the difference between school H and school F is significant.

Question 2: school D differs significantly from the other schools and school G scores significantly higher than the other schools, with the exception of school H.

### Questionnaire

Table 2 shows the responses to the two questions by medical school. Note that 100% represents a different amount of knowledge in the two questions.

The results show that most students thought they had acquired less than half of the anatomy knowledge they could have acquired at the end of year four, with no significant differences between schools. PBL students and non-PBL

students had similar perceptions with regard to their anatomy knowledge at the end of fourth year.

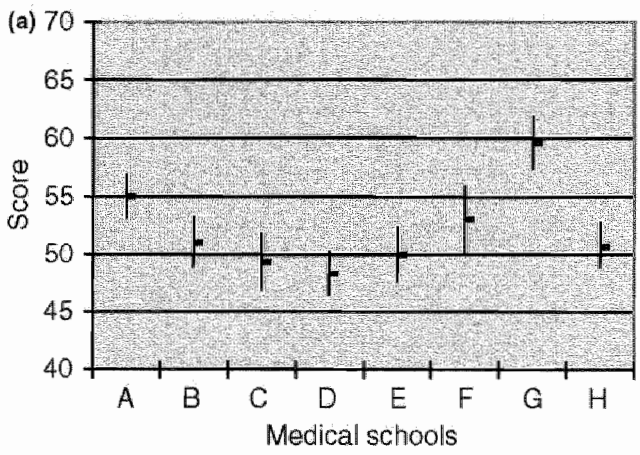
The responses to the second question show that 65.2% of all students perceived they had mastered less than half of the knowledge required on graduation (end year six). The students of schools G and H were significantly more positive about their knowledge levels than the students of school D. The perceived knowledge level of the students of school A, the PBL school at Maastricht, did not differ from that of students at other medical schools.

**Test results**

The reliability of the subtests was expressed by Cronbach's alpha for internal consistency. For the subtest with clinical context, alpha = 0.84; for the subtest without clinical context, alpha = 0.29.
The mean score on the items with clinical context was 52.3% (n = 356, SD 8.1, range 34.2 - 75.4%). The mean score on the subtest without clinical context was 60.3% (n = 350, SD 7.6 , range 35.4-85.4%).

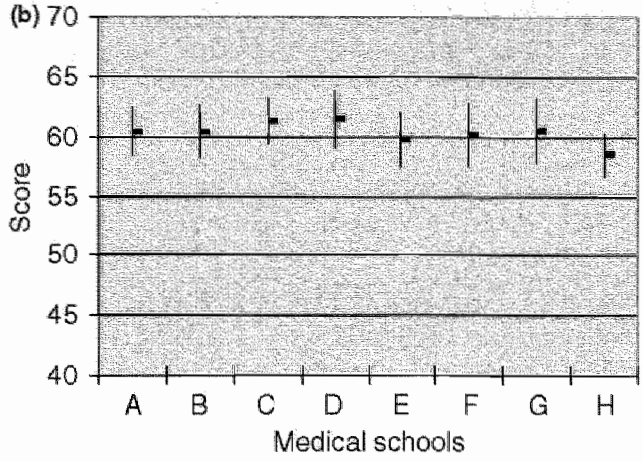
Figure 1a and 1b show the means plus 95% confidence intervals of the scores per school. The subtest with clinical context showed significant differences between schools, whereas the subtest without clinical context revealed no such differences.

Figure 1a: 95% CI of results in subtest with context per school (excluding student-instructors).




Students at school G scored significantly higher in the subtest with clinical context than the students at the other schools ($p < 0.000$). School D had a significantly lower score than schools A, F and G ($p < 0.05$). On the items with clinical context, PBL school A had a score comparable to those of the other schools.

Figure 1b: 95% CI of results in subtest without context per school (excluding student-instructors).




## Discussion

We cannot completely rule out the possibility of pre-existing systematic differences between students from different medical schools. Given the homogeneity of Dutch high school education and the national admission procedure to medical school, however, significant differences between schools in student levels are unlikely.
Only the students of schools A and G were representative of their class. The participating students from schools C, D, E and H scored higher than their class on a regular exam and for schools B and F representativeness could not be tested. The students of schools A and G performed better on the anatomy tests than the students from the other schools. This suggests that the real differences between schools are likely to be in the same direction and probably larger than found in this study.

The Maastricht students and the students of two other schools were familiar with the type of questioning in the sub-test without context. However, no significant differences were found with this test. Although the sub-test with clinical context was constructed in Maastricht, the Maastricht students were not familiar with the type of questioning used in this sub-test.

The results for the research question concerning students' perceived knowledge levels, showed substantial perceived deficiencies for PBL and non-PBL students alike. The majority of students indicated that they had mastered less than half of the anatomy knowledge they could have mastered at the end of year four and less than half of the knowledge required on graduation. The fact that students perceive that their knowledge levels fall below requirements gives cause for concern. During the clerkships in years 5 and 6 no specific attention is given to basic sciences, including anatomy. This makes it doubtful whether students will be able to achieve what they regard as the required level on graduation.

Regarding the actual knowledge levels of PBL and non-PBL students, no differences between schools were found with the sub-test without clinical context. The reliability of this test appeared to be low, indicating that the scores are highly unstable. It is therefore not surprising that no significant differences were found between schools on this test.

Differences between schools were found for the sub-test with clinical context. This may be due to the context, but also to the different types of questioning. The fact that PBL-students obtained scores that were similar to those of the other students suggests that problem-based learning as an educational method does not lead to a lower level of anatomy knowledge. Although the best results on the anatomy test were obtained by traditional school G, there was no evidence of a better performance by the traditional schools in general.

The study showed no differences in anatomy level between PBL-schools and non-PBL schools, but it offers some interesting indications of other relevant educational differences. Although we cannot reveal the identity of the schools, we can highlight some differences in anatomy teaching between the schools. Combined with the study results, these differences may point towards fruitful avenues for further study of effective basic science teaching.

School G, which scored significantly higher than the other schools on the test with context, schedules twice as much time for anatomy teaching as the other schools. Both school G and school A, which had the second highest test result in the study, teach anatomy in a clinically meaningful context, such as patient problems, diagnostics and therapeutic features. The importance of context in learning is supported by Regehr et al., who identified relevance of the material and the context in which it is embedded as factors with a positive effect on retention.[2] It is often assumed that learning in a clinical context is a characteristic of problem-based learning. The fact that at school G learning in context yields good results suggests that more traditional training programmes can also teach successfully in a clinically relevant way.

The better scoring medical schools offer many anatomy features more than once during the pre-clinical years. There is evidence of a beneficial effect on learning if topics are repeated. Blunt and Blizard showed a strong effect of reinforcement of initial learning by repetition in later courses.[18]

The study design does not allow any conclusions to be drawn on the basis of these tentative associations between students' results on anatomy tests and teaching methods like time spent on anatomy teaching, repetition and teaching in context. It may be interesting, however, to pursue these relationships in further studies.
Another topic for further study is the appropriate level of anatomy knowledge on graduation. It cannot be ascertained whether students are accurate in perceiving that their knowledge is deficient, because there is no standard available for an absolute interpretation.

In conclusion, the results of this study suggest that students from a PBL school experience similar deficiencies in anatomy knowledge compared with their colleagues from other schools. The discrepancy between what

students think they know and what they think they need to know gives cause for concern. No significant differences were found between anatomy test scores of PBL students and non-PBL students. Future studies might address a standard for anatomy knowledge, the effects of contextual learning and of repetition of topics.

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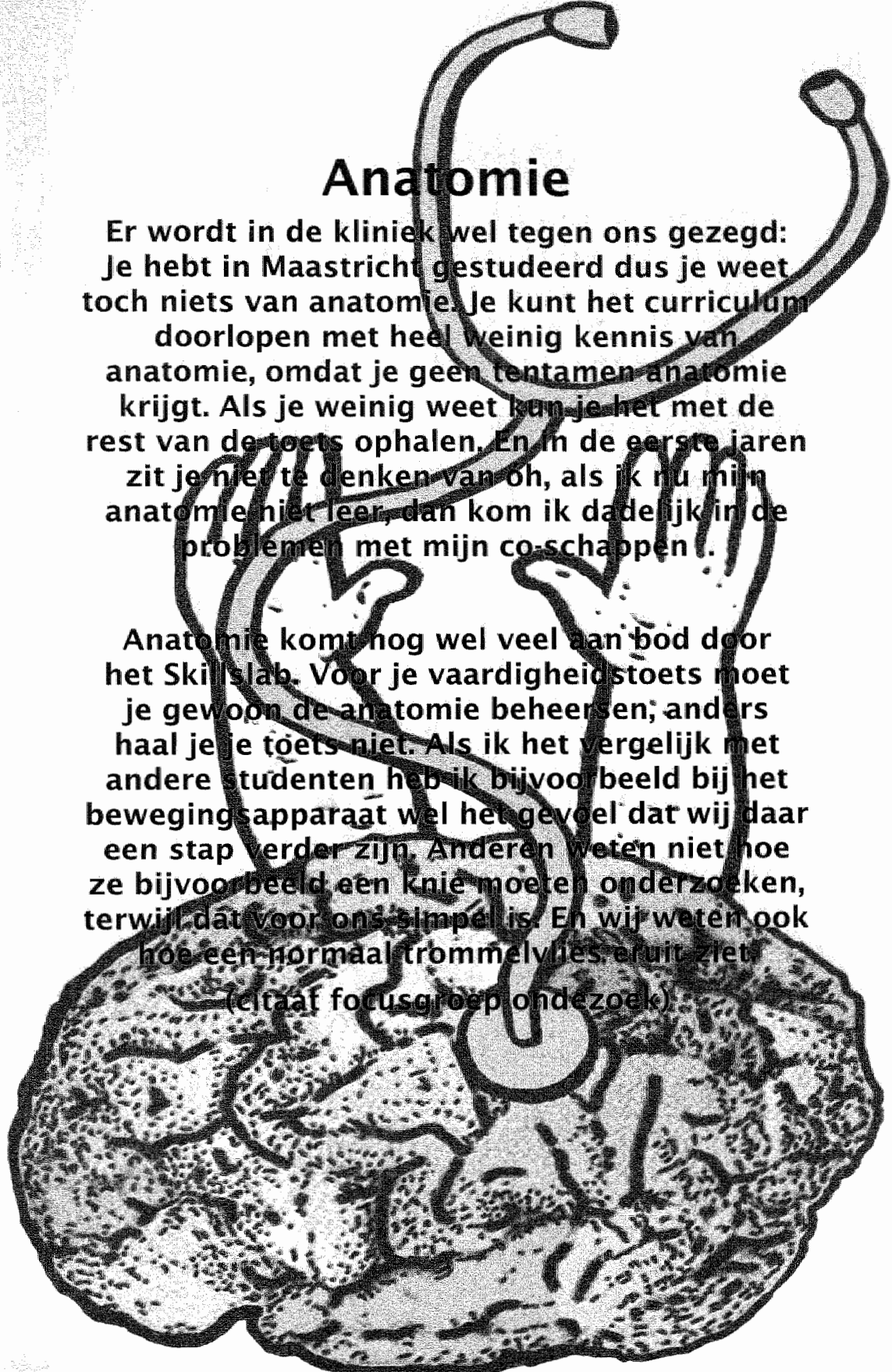
# Anatomie

Er wordt in de kliniek wel tegen ons gezegd: Je hebt in Maastricht gestudeerd dus je weet toch niets van anatomie. Je kunt het curriculum doorlopen met heel weinig kennis van anatomie, omdat je geen tentamen anatomie krijgt. Als je weinig weet kun je het met de rest van de toets ophalen. En in de eerste jaren zit je niet te denken van oh, als ik nu mijn anatomie niet leer, dan kom ik dadelijk in de problemen met mijn co-schappen.

Anatomie komt nog wel veel aan bod door het Skillslab. Voor je vaardigheidstoets moet je gewoon de anatomie beheersen, anders haal je je toets niet. Als ik het vergelijk met andere studenten heb ik bijvoorbeeld bij het bewegingsapparaat wel het gevoel dat wij daar een stap verder zijn. Anderen weten niet hoe ze bijvoorbeeld een knie moeten onderzoeken, terwijl dat voor ons simpel is. En wij weten ook hoe een normaal trommelvlies eruit ziet.

(citaat focusgroep onderzoek)



# 5
# Do students have sufficient knowledge of clinical anatomy?

Published as: Prince KJAH, Scherpbier AJJA, Van Mameren H, Drukker J, Van der Vleuten CPM. Do students have sufficient knowledge of clinical anatomy? Medical Education 2005; 39: 326-32

## Abstract

Comparisons of anatomy knowledge levels of students from various curricula show either no differences or small differences to the detriment of innovative schools. To pass judgement on the general level of students' anatomy knowledge, we need an absolute standard. The purpose of this study was to compare students' levels of anatomy knowledge as measured by a case-based anatomy test with standards set by different groups of experts.

A modified Angoff procedure was used to establish an absolute standard against which the students' results could be evaluated. Four panels of nine anatomists, seven clinicians, nine recent graduates and nine Year 4 students, respectively, judged 107 items of an anatomy test. The students' results on these items were compared with the standards obtained by the panels.

If the standard established by the panel of Year 4 students was used, 64% of the students would fail the test. The standards established by the anatomists, clinicians and recent graduates would yield failure rates of 42%, 58% and 26%, respectively.
According to the panels' standards, many students did not know enough about anatomy. The high expectations that the Year 4 students appeared to have of their peers may contribute to students' uncertainty about their level of anatomy knowledge.

## Introduction

In every medical curriculum educators have to strike an optimal balance between basic sciences and clinical sciences. Innovative educational approaches, such as problem-based learning (PBL), are aimed at integrating basic and clinical sciences. However, concerns have been raised about the level of basic science knowledge attained by students in innovative curricula. Studies on the outcomes of PBL have shown contradictory results, sometimes indicating that PBL schools equip their students with less basic science knowledge than do more traditional medical schools.[1-4]

In general, the integrated PBL approach has seemed to be associated with uncertainty among students about their basic sciences knowledge as well as alleged deficiencies in this knowledge, particularly in clinical anatomy.[5,6] A comparative study among students at Dutch medical schools did not support these earlier findings.[7] In other words, PBL students felt equally confident (or uncertain) about their level of anatomy knowledge as students from other curricula. The same study showed relatively small differences between the different schools in the students' actual clinical anatomy knowledge.[7] The results of the PBL students were comparable to those of their colleagues at other medical schools.

In other words, the evidence from comparisons of anatomy knowledge acquired by students in innovative and other curricula is ambiguous. This ambiguity may be explained by the considerable variation in curricular designs and implementations, due to the fact that the PBL label is attached to a variety of heterogeneous educational activities. Other developments can also impact on students' anatomy knowledge, such as the reduction in the available time in the curriculum and the shortage of suitable staff to teach anatomy.[8] Whatever causes these differences may have, it still remains to be ascertained whether medical students across the curricular spectrum attain a level of anatomy knowledge that is considered adequate.

This study sought to answer the question: do medical students in the Netherlands have sufficient knowledge of anatomy at the end of Year 4 (i.e. at the end of the pre-clinical curriculum)? Having examined the differences in knowledge between students from different curricula in a previous study, we now wanted to measure students' anatomy knowledge against an absolute benchmark.[7] Although there is no gold standard in common use, there are many acceptable methods for generating an absolute standard. A popular method for standard setting is the modified Angoff procedure, which is supported by research.[9,10] The modified Angoff procedure involves the estimation of the performance of borderline examinees by a panel of judges. The judges must be knowledgeable in the content area of the examination.

We expected different panels of judges with different levels of expertise to reach different outcomes, which would be in line with the literature.[11] As content experts who are the most distant from students in terms of expertise, anatomists may have the highest expectations of students, which is why we expected the anatomists to set a relatively high standard. We assumed that clinicians would give a lower estimation, because they would expect students to continue to learn about anatomy during their clerkships.

Because students are content experts as consumers of the curriculum, we expected them to be more familiar with the candidates than the teachers. Verhoeven et al. showed that recently graduated students showed more agreement and produced more reliable Angoff estimates than a panel of staff item writers.[11] We expected recently graduated doctors to make the most realistic estimation. The estimations of Year 4 students were expected to be somewhat higher, due to their uncertainty about their own knowledge level.

In order to answer our research question, we determined whether students have sufficient knowledge of clinical anatomy by comparing the anatomy test results of a national sample of Year 4 medical students with the absolute standards set by four panels of different judges, consisting of anatomists, clinicians, recent graduates and Year 4 students, respectively.

## Methods

### Materials

We used the results obtained by a sample of students from the eight medical schools in the Netherlands on the same computerised, case-based, clinical anatomy test.[7] Clinical anatomy is defined as anatomy that is indispensable for a good understanding of the medical physical examination, modern imaging techniques, diagnosis and many invasive and non-invasive procedures. The test consisted of 138 items, linked to 16 patient cases. The items comprised open questions, multiple-choice questions and true-false questions, without a do-not-know option. The clinically contextualised items required students not only to recall names of structures, but also to apply their knowledge to clinical problems. Examples of (parts of) patient cases with accompanying items are shown in the Appendix.

Because of time constraints, we used 13 cases from this test, with an accompanying 107 items. The cases were related to the domains of ENT, family medicine, neurology, surgery, orthopaedic surgery, internal medicine, cardiology, ophthalmology and radiology.

### Student results

The test was administered to a sample of all students in Year 4 of the 6-year Dutch undergraduate medical curriculum shortly before the beginning of their clerkships. A total of 348 students answered all 13 cases. The overall test score was calculated as the percentage correct answers. Because the number of questions varied across cases, scores were calculated per case and then averaged.

### Angoff procedure

A modified Angoff procedure was used to establish an absolute passing score for the anatomy test.[10] Prior to the standard setting procedure, the judges received a letter describing the purpose of the study and a paper copy of the anatomy test (the actual test was computerised).

### Judges

We assembled four panels of judges for the Angoff procedure:

1) anatomists;
2) clinicians;
3) graduates, and
4) Year 4 medical students.
We aimed to have 6-10 judges per panel.[10,12]

The anatomy departments at the eight medical schools in the Netherlands were each asked to supply judges. Nine anatomists from seven medical schools participated. The panel of clinicians was recruited from staff of the Maastricht Academic Hospital. We invited one person from each of nine specialties. Seven clinicians, representing all the domains included in the test, participated. For the graduate panel we invited recent graduates and Year 6 students at Maastricht Medical School who were close to graduation. The group of 'recent graduates' consisted of four graduates and five students who were in their final weeks before graduation. The student panel consisted of nine Year 4 students from Maastricht Medical School.

Each panel of judges met for one 3-hour session with the same two moderators (KP and AS). The judges were asked to imagine a borderline student at the end of Year 4 and estimate for each test item, taking account of item content and difficulty, the probability that such a borderline student would know/give the correct answer. Because the items did not have a do-not-know option, the judges were instructed to apply a correction for guessing. The judges were given the correct answers to the test items. After a discussion of the items and on the basis of empirical data (the actual percentages of correct answers given by the students who took the test (p-values)), the judges were able to revise their estimates. This procedure was repeated until the judges had given Angoff estimates for all the items.

**Statistical Analysis**

Each judge gave two estimates for each test item, one before and one after the item had been discussed by the panel. The two estimates were used to calculate two separate scores. The individual judges' Angoff scores were established by averaging each judge's estimations across items per case, and then averaging these estimations across all 13 cases. The mean Angoff score per panel was arrived at by averaging the mean scores of the individual judges. Compared with the initial scores of the judges, the estimates after the panel discussion were slightly more lenient and the confidence intervals smaller. Only these scores were used for further analysis and reported in this chapter.

In order to estimate the variability of these scores, generalisability was used following the procedures as described by Verhoeven et al.[12] A root mean square error (RMSE) was established and used to estimate a confidence interval around the mean Angoff score for each panel. The scores of the four panels were compared.
Because a high correlation between the Angoff estimate and the actual item score can be regarded as an indicator of validity, the Pearson correlation was calculated for the mean of the panel estimates per item and the P-values (percentage correct).
Student scores were compared with the various Angoff scores and the pass/fail ratio was calculated for each Angoff score.

## Results

The mean Angoff score (the mean of all judges' estimates across 13 cases after the panel discussion) was 51.7%. Table 1 presents descriptive statistics of the judges' Angoff scores.

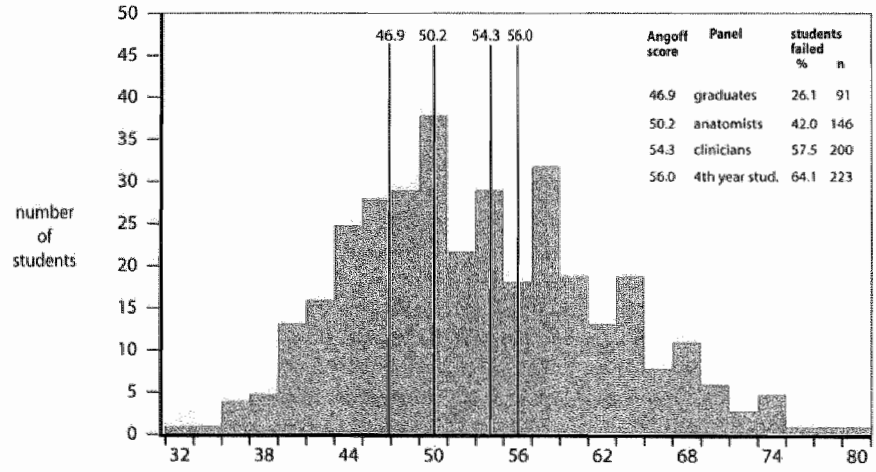
The use of the variability index RMSE allows estimation of confidence intervals around the Angoff mean and inference of statistical significance between differences. The results show some significant differences between the standards set by the different panels. Both the anatomists and the graduates set the standard significantly lower than the Year 4 students and the clinicians.

Table 1: Angoff scores, RMSE, confidence intervals after group discussion of the 4 panels, including the number and percentage of students that would fail given the Angoff score and the Pearson correlation of each panel based on 13 cases/107 items.

| Panel | Panel size (n) | Angoff score | RMSE | 95% CI | N failed N (%) | Correlation Angoff P-value |
|---|---|---|---|---|---|---|
| Anatomists | 9 | 50.2 | 1.03 | 48.2 - 52.2 | 146 (42.0%) | 0.80 |
| Clinicians | 7 | 54.3 | 0.76 | 52.8 - 55.8 | 200 (57.5%) | 0.83 |
| Graduates | 9 | 46.9 | 0.88 | 45.2 - 48.6 | 91 (26.1%) | 0.84 |
| Year 4 students | 9 | 56.0 | 0.85 | 54.4 - 57.7 | 223 (64.1%) | 0.91 |

All panels obtained correlations of 0.8 or more between item difficulty (P-value) and the item Angoff estimates.
The mean score across 13 cases obtained by the students sitting the test (n = 348) was 53.20. Figure 1 shows the distribution of the students' scores (in grey) and the four panels' Angoff scores after discussion (black lines).

Figure 1: The distribution of the students' test results (shaded) and the Angoff scores of the 4 panels of judges.




The area to the left of the Angoff scores in Fig. 1 represents the number of students failing the test if that score were to be used as the pass/fail cut-off point. The failure rates associated with the Angoff scores of the graduates,

anatomists, clinicians and Year 4 students were 26.1%, 42.0%, 57.5% and 64.1%, respectively.

## Discussion

This study was performed to set an absolute standard for an anatomy test to ascertain whether or not medical students have an adequate knowledge of clinical anatomy.

The various Angoff estimates yielded percentages ranging from 26% to 64% of students failing to demonstrate the required knowledge level. In short, every standard that emerged from the Angoff procedure would result in a substantial number of students failing to perform to standard, although the number of students failing varied considerably depending on the type of judges in the Angoff panel.

Although the absolute differences between the panels' Angoff scores were small, the different scores led to substantial differences in failure rates. This strong impact on the pass/fail ratio is caused by the fact that the Angoff scores of the four panels were all in the centre of the distribution of the students' test results. As a consequence small differences in standards led to dramatic differences in outcomes.

There are several possible explanations for the diversity of the Angoff scores. We expected the anatomists to set a high standard based on their reported dissatisfaction with students' anatomy knowledge. However, the results showed that the anatomists set the standard significantly lower than the clinicians and the Year 4 students. Possibly, the anatomists' more extensive contact with students in the pre-clinical years afforded them a better insight into the students' actual knowledge levels. However, this does not necessarily imply that they were satisfied with the students' knowledge levels. If we had asked them to indicate students' desired rather than actual knowledge level, we might well have found considerably higher estimates. Clinicians, on the other hand, have little contact with pre-clinical students and thus may be unable to give a good estimate of what students actually know. As expected, the graduates set the lowest standard. A possible explanation is that the judges in the panel of graduates had recently or were about to finish their clerkships and thus had a good idea of the level of knowledge required in practice. Secondly, the graduates were aware of how much they had learned about anatomy in the clerkships and therefore were likely to expect less of Year 4 students.[13] One might expect Year 4 students to have an accurate picture of their peers' knowledge. However, this assumption was not confirmed by the results: Year 4 students set the highest standard, resulting in a 64% failure rate. Apparently, they overestimated the achievements of their peers, which might offer an explanation for their uncertainty about their own knowledge.

Apart from the difficulties that arise when we want to appraise students' anatomy knowledge, these results also show that there is no consensus on what students need to know. This alone can be a cause of uncertainty among students. Clear guidelines as to the required anatomy knowledge should be developed and agreed on by anatomists and clinicians, with students and

graduates contributing to the process.

The differences between the Angoff scores also show the limitations of this Angoff method as well as the importance of the selection of the judges. The procedure may be flawed due to judges' insufficient knowledge about students, particularly borderline students. Variable outcomes of Angoff procedures are not surprising in themselves,[14] but the considerable magnitude of the differences we found was rather unexpected.

In this study, the judges were given feedback in the form of the actual test results. The participants said that it was difficult for them to estimate the level of the borderline student while receiving feedback in the form of the average student's results. This may have led to higher estimates than they would have given otherwise. However, the fact that all four panels were exposed to the same feedback makes it unlikely that the higher estimates accounted for all the differences between the groups.

All panels were well aware of item difficulty, as can be concluded from the high Pearson correlations. The more experienced panels (the anatomists because they taught the students and the graduates because they had recently finished their clerkships and knew what knowledge was required) set lower standards than the less experienced panels (the clinicians, who had hardly any contact with Year 4 students and the Year 4 students, who did not yet know what would be expected of them in the clerkships). The standards set by the more experienced judges - the anatomists and the recent graduates - would appear to be the most plausible and justifiable. If these standards were to be applied, between a quarter and a half of the students in this study would fail the test. This applies equally to PBL and non-PBL students, who had similar test results, as has been shown.[7] This can be seen as an indication that students' anatomy knowledge is insufficient. However, the possibility of overestimation cannot be ruled out, particularly as the literature shows that students' performance tends to be overestimated.[11]

## Conclusion

The results of this study show a sizeable discrepancy between students' performance on an anatomy test and the standards set by experts. This suggests that there is cause for concern regarding students' level of anatomy knowledge. It is possible that similar research in other topics, such as physiology or pharmacology, would yield similar results. In other words, the problem may well be that it is not students' anatomy knowledge that is deficient, but that there is a more general problem in identifying the content of medical curricula for different disciplines and establishing how much knowledge students should acquire. The significant differences between the standards set by staff (clinicians and anatomists) in our study support this assumption. Further research will be needed to clarify whether or not students' knowledge is deficient and, if so, how it can be improved.

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## Appendix

### Examples of test items

#### Patient case description 1

The general practitioner (GP) examines the eye movements of Mrs Ommen. He asks her to look in all directions. Her right eye does not move to the right when she looks in that direction. The GP suspects a paralysis of a specific extra-ocular muscle.

Item: Which muscle is involved?
Answer: Lateral rectus

#### Patient case description 2

Paula Woods, 17 years of age, enters the emergency department hopping on 1 leg. Two hours earlier she sprained her right ankle during a badminton match. She felt something crack at the outside of her foot. Her ankle swelled immediately. She was able to stand on it, although this hurt a lot. She did not cool the ankle.

The doctor in the emergency department suspects an inversion trauma.

Item: The talus forms a synovial joint with the tibia and fibula (=talocrural joint), the calcaneus (=subtalar joint) and the calcaneus and navicular bone (talocalcaneonavicular joint).

Inversion of the foot takes place:

a only in the talocrural joint
b only in the subtalar joint
c in both the talocrural joint and the subtalar joints
d in both the subtalar and the talocalcaneonavicular joints

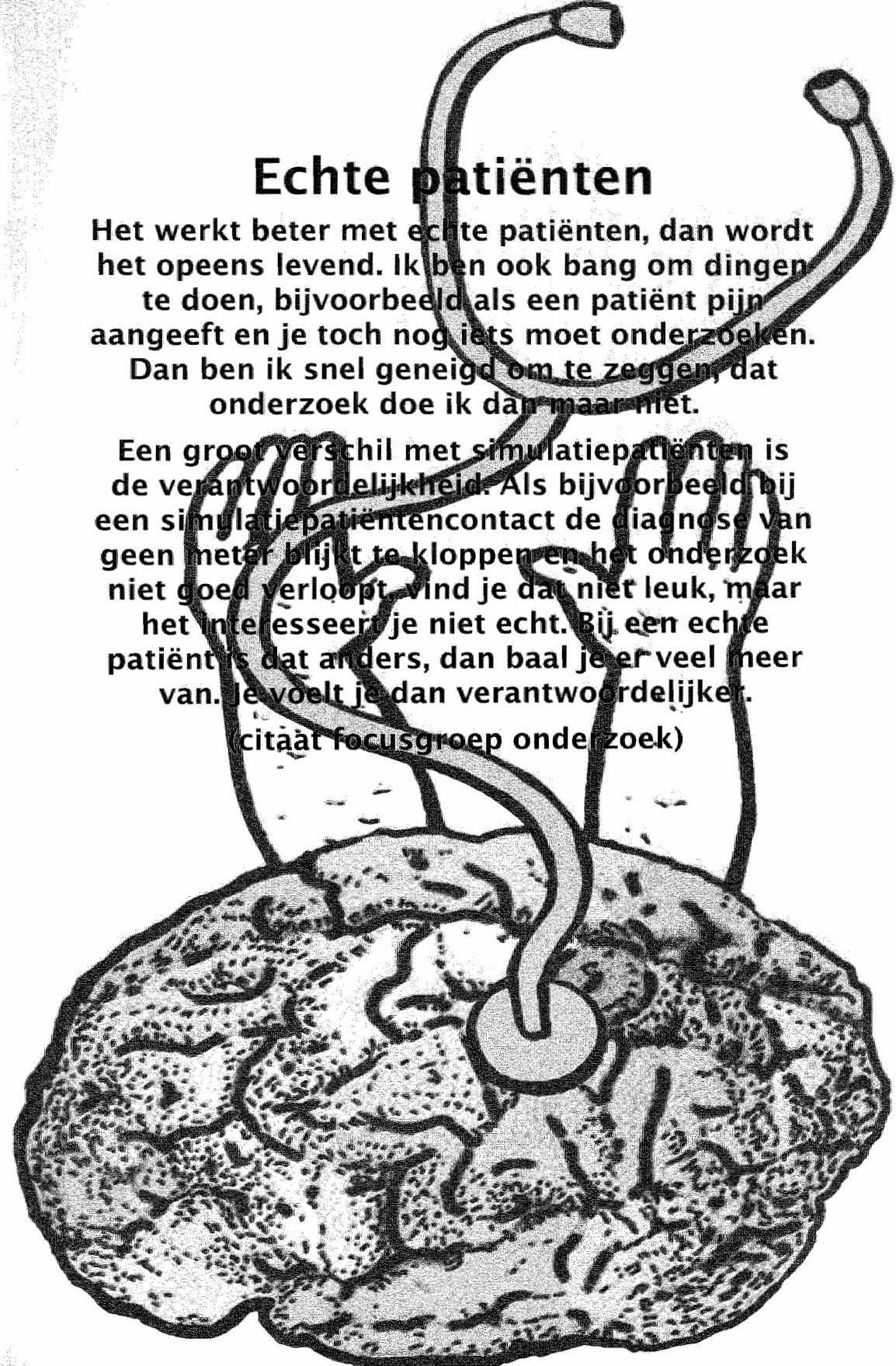
Answer: d

# Echte patiënten

Het werkt beter met echte patiënten, dan wordt het opeens levend. Ik ben ook bang om dingen te doen, bijvoorbeeld als een patiënt pijn aangeeft en je toch nog iets moet onderzoeken. Dan ben ik snel geneigd om te zeggen, dat onderzoek doe ik dan maar niet.

Een groot verschil met simulatiepatiënten is de verantwoordelijkheid. Als bijvoorbeeld bij een simulatiepatiëntencontact de diagnose van geen meter blijkt te kloppen en het onderzoek niet goed verloopt, vind je dat niet leuk, maar het interesseert je niet echt. Bij een echte patiënt is dat anders, dan baal je er veel meer van. Je voelt je dan verantwoordelijker.

(citaat focusgroep onderzoek)



# 6
# General competencies of problem-based learning (PBL) and non-PBL graduates

Published as: Prince KJAH, Van Eijs PWLJ, Boshuizen HPA, Van der Vleuten CPM, Scherpbier AJJA. General competencies of problem-based learning (PBL) and non-PBL graduates. Medical Education; 2005: 39: 394-401.

## Abstract

Junior doctors have reported shortcomings in their general competencies, such as organisational skills and teamwork. We explored graduates' perceptions of how well their training had prepared them for medical practice and in general competencies in particular. We compared the opinions of graduates from problem-based learning (PBL) and non-PBL schools, because PBL is supposed to enhance general competencies.

We analysed the responses of 1159 graduates from 1 PBL and 4 non-PBL schools to a questionnaire survey administered 18 months after graduation. Compared with their non-PBL colleagues, the PBL graduates gave higher ratings for the connection between school and work, their medical training and preparation for practice. According to the graduates, the most frequently used competencies with sufficient coverage during medical training were expert knowledge, profession-specific skills and communication skills. The majority of the PBL graduates, but less than half of the non-PBL graduates, indicated that communication skills had been covered sufficiently. All the graduates called for more curriculum attention on working with computers, planning and organisation, and leadership skills. More PBL graduates than non-PBL graduates indicated that they had learned profession-specific methods, communication skills and teamwork in medical school.

Overall, the graduates appeared to be satisfied with their knowledge and skills. The results suggest that the PBL school provided better preparation with respect to several of the competencies. However, both PBL and non-PBL graduates identified deficits in their general competencies, such as working with computers and planning and organising work. These competencies should feature more prominently in undergraduate medical education.

## Introduction

Many studies have addressed the experiences of junior doctors when they enter the world of clinical practice. Junior doctors complain about the excessive workload, stress, inadequate supervision and insufficient support from senior staff.[1-4] These problems are typically related to the working environment of the hospital. Junior doctors also mention problems associated with their own shortcomings in knowledge, skills and general competencies. A study by Hannon showed that interns considered themselves to be incompetent with respect to the skills and competencies required of an intern.[5] In another study, more than 50% of junior doctors expressed a need for additional training in the technical and management aspects of the work of a doctor prior to the pre-registration year.[6] Lambert et al. reported that 22% of pre-registration house officers thought they were inadequately prepared for some of the clinical tasks they were expected to perform, with 80% of subjects in that study saying that they did routine work that did not require a medical qualification.[7] Junior doctors have often reported shortcomings in general competencies. Rolfe et al. found that junior doctors had difficulty setting priorities, lacked experience with organisational skills before qualification and needed additional training in practical procedures.[4] A qualitative study by Prince et al. showed that junior doctors felt confident about their skills and diagnostic knowledge, but had difficulty coping with some of the other aspects of their work, such as the sudden increase in responsibilities, the lack of practical procedural knowledge, contacts with other health care workers, and teamwork.[8]

Many studies have investigated the effectiveness of undergraduate medical education in preparing students for medical practice.[9-15] The focus of most of these studies was students' actual or perceived preparedness with regard to knowledge and skills. As for knowledge and physical examination skills, most junior doctors reported general satisfaction with the way their training had equipped them for medical practice.[5, 10, 11] However, only a few studies have addressed how well undergraduate training prepares students regarding general competencies. Clack found that graduates felt ill-equipped with respect to patient management skills, including coping with stress, time management, ability to prioritise, and resource management.[11]

New educational approaches aim to provide students with general competencies. A prominent exemplar of such an approach is problem-based learning (PBL), which purports to enhance problem-solving skills, independent learning and teamwork skills.[16] There is indeed some evidence that graduates from PBL schools are better prepared in terms of general competencies than their colleagues from non-PBL schools. Busari et al. showed that graduates from a PBL school felt better prepared in psychosocial and interpersonal skills.[10] Antepohl et al. reported that graduates from a PBL curriculum felt well prepared for professional practice in the pre-registration period and specialty training, especially in terms of skills for communicating with patients, co-operation with other health professionals and the development of critical thinking and a scientific attitude.[17]

Schmidt and Van der Molen showed that alumni of a PBL medical school considered themselves to have been better prepared than their colleagues

who had been trained in traditional curricula with respect to the skills needed to collaborate with others, solve problems, run meetings and work independently.[18] There was no difference in general academic knowledge and the ability to write reports or papers.[18]
However, the above-mentioned studies mainly addressed the competencies that PBL is expected to enhance. They did not look at graduates' competencies from the perspective of the demands of the workplace. The purpose of our study was to explore junior doctors' perceptions concerning the general competencies required for professional practice. As PBL is supposed to enhance those competencies, we compared graduates of a PBL curriculum with graduates of non-PBL medical schools. For this comparison we used data about graduates from Maastricht Medical School (PBL) and 4 non-PBL medical schools in the Netherlands, drawn from an existing alumni database.

## Methods

### Subjects

We analysed the responses to a questionnaire administered 18 months after graduation to 2876 doctors who had graduated in 1999, 2000 and 2001. Responses were available for 1298 graduates (response rate 45.1%) from 1 PBL school and 4 non-PBL schools. Non-PBL schools may differ considerably, but when the graduates surveyed in this study were students, the non-PBL schools in this study all had traditional, lecture-based curricula that differed more from the small group PBL programme than from one another. After graduation most graduates worked in health care, but a small number ended up in other settings. The data for the 139 graduates who had no job, an unknown job or a job outwith health care were excluded from the analysis. This meant that data for 1159 graduates, including 239 graduates from a PBL school, were available for analysis.

Of the 1159 respondents, 36.9 % (n = 428) were male, which reflected the gender distribution throughout the entire cohort. There were no significant differences between the PBL and non-PBL schools in male : female ratio. The mean age of the participants was 27.9 years (SD 2.5 years). The age distribution did not differ significantly between the schools. Most graduates (62.8%) were in specialty training in a hospital; 14.8% had jobs in general practice or a nursing home, 10.3% in public health, 10.3% in research, 0.5% in medical education or health sciences education and 1.4% in health care, but not as a medical doctor. The proportion of graduates practising medicine to graduates with jobs in research or teaching was similar for the PBL graduates (87.9% versus 12.1%) and the non-PBL graduates (88.3% versus 11.7%).

### Questionnaire

The Research Centre for Education and the Labour Market surveys all graduates from Maastricht University 18 months, 5 and 10 years after graduation. It also surveys graduates from all Dutch universities 18 months after graduation. For this purpose, the Centre administers a comprehensive questionnaire containing questions about education, the transition from university to workplace, the current labour market and activities after graduation.
We only analysed responses to questions that were relevant to our research

question (i.e. questions pertaining to medical education as preparation for practice and the connection between training and work). Graduates from 3 of the [8] Dutch medical schools had received a slightly different questionnaire, which did not include the main items of interest to our study. This meant that the responses of graduates from 5 medical schools were available for analysis.

The questionnaire asked graduates to rate the quality of their undergraduate training and their preparation for practice on a scale from 1-10. The responses to items asking graduates about the connection between their training and their current job were rated on a four-point scale (good, sufficient, moderate or poor). The questionnaire also contained fourteen items enquiring about general workplace competencies developed by an independent institution, the Research Centre for Education and the Labour Market, and standardised for graduates from different schools (medicine, law, economics, etc.). Two of the workplace competencies, handling figures and international orientation, were left out of the analysis because they were considered to have no particular relevance to medicine, which was confirmed by graduates' responses to those items. This left twelve competencies for inclusion in the analysis. The graduates were asked to indicate on a five-point scale how frequently they used these competencies in their work and where they had mostly learned them (medical school, workplace, or elsewhere). Graduates were also asked to name a maximum of three competencies that had received adequate coverage in the undergraduate curriculum and a maximum of three competencies that they felt had been underrepresented in the curriculum.

### Data analysis

The results are presented separately for PBL graduates and non-PBL graduates. Because not all items were answered by all respondents, the number of responses (n) is given in each table. Means and standard deviations were calculated for perceived quality of training and preparation for practice. Students t-tests were used to analyse the differences between PBL graduates and non-PBL graduates. The results on the connection between school and work are expressed as the percentages of the total number of responses in the four response categories (good, sufficient, moderate or poor). Differences between the PBL school and the non-PBL schools were analysed with Mann-Whitney test for non parametric data. Means (scale 1 - 5) and SDs are reported for the extent to which junior doctors used certain competencies. Differences were analysed with a t-test. Coverage of competencies in the curriculum and the setting where competencies had been acquired are reported as the percentage of the total number of graduates reporting sufficient or insufficient coverage and having acquired a competency in medical school, at work or elsewhere. We used cross tabulations and chi-squared tests to analyse differences between schools with respect to where graduates had learned these competencies.

## Results

### General opinions about medical school

PBL graduates rated the quality of their training and preparation for practice significantly more highly than did the graduates from the other schools (Table 1).

Table 1: Graduates' opinions about the quality of undergraduate medical training and preparation for practice on a scale of 1-10.

| | PBL Graduates | | Non-PBL graduates | |
|---|---|---|---|---|
| | n | Mean (SD) | n | Mean (SD) |
| Quality of training | 229 | 7.6 (0.8) * | 878 | 7.1 (0.8) * |
| Preparation for practice | 227 | 7.3 (1.1) | 872 | 6.5 (1.3) * |

*Significant difference between PBL versus non-PBL medical schools ($P < 0.001$).

## The connection between school and work

The majority of both PBL graduates (84.1%) and non- PBL graduates (76.8%) indicated that the connection between their training and their current job was good (Table 2). The ratings of the PBL graduates were higher than those of the other graduates, but the differences were statistically not significant.

Table 2: Graduates' opinions about the connection between school and work (4-point scale).

| | PBL Graduates (n=239) | Non-PBL Graduates (n=917) |
|---|---|---|
| Good | 84.1% | 76.8% |
| Sufficient | 14.2% | 20.2% |
| Moderate | 1.7% | 2.4% |
| Poor | 0.0% | 0.2% |

## General competencies

The competencies with the highest reported frequency of usage were expert knowledge, profession-specific skills and communication skills (Table 3).

Table 3: Graduates' opinions about how often they use competencies in their work (scale 1-5, 1= I do not use this competency, 5 = I use this competency a lot).

| Competencies | PBL graduates | | Non-PBL graduates | |
|---|---|---|---|---|
| | N | Mean (SD) | N | Mean (SD) |
| Expert knowledge | 238 | 4.56 (0.65) | 910 | 4.44 (0.73) * |
| Profession-specific skills | 237 | 4.41 (0.71) | 907 | 4.24 (0.85) ** |
| Computer skills | 239 | 2.99 (1.11) | 906 | 3.14 (1.10) |
| Communication skills | 239 | 4.76 (0.53) | 907 | 4.67 (0.60) * |
| Teamwork skills | 239 | 4.33 (0.70) | 906 | 4.22 (0.84) |
| Planning and organisation skills | 239 | 3.90 (0.91) | 903 | 3.88 (0.89) |
| Leadership skills | 238 | 2.95 (1.13) | 904 | 2.87 (1.07) |
| Independence | 239 | 4.37 (0.67) | 905 | 4.34 (0.70) |
| Creativity | 238 | 3.41 (1.07) | 904 | 3.31 (1.03) |
| Initiative | 239 | 4.05 (0.79) | 906 | 3.96 (0.76) |
| Dealing with change | 239 | 4.03 (0.86) | 906 | 3.95 (0.93) |
| Accuracy | 238 | 4.41 (0.80) | 905 | 4.41 (0.72) |

* Significant difference $P < 0.05$ PBL versus non-PBL medical schools

** $P < 0.01$

Teamwork, independence and accuracy were also used frequently. Statistically significantly higher usage by PBL graduates was found for expert knowledge, profession-specific skills and communication skills.

Not all graduates mentioned the maximum of three competencies with either sufficient or insufficient coverage by the curriculum. No competency in either category was mentioned by 6% of the PBL graduates and 9% of the non-PBL graduates (Table 4).

Table 4: Percentage of graduates of PBL and non-PBL schools that considered coverage of competencies in medical school to have been sufficient or insufficient.

| | Sufficient | | Insufficient | |
|---|---|---|---|---|
| Competencies | PBL | Non-PBL | PBL | Non-PBL |
| Expert knowledge | 72.0% | 82.9% | 8.4% | 3.9% |
| Profession-specific skills | 52.7% | 49.0% | 13.0% | 17.5% |
| Computer skills | 1.3% | 7.0% | 46.0% | 33.5% |
| Communication skills | 82.8% | 41.1% | 3.3% | 28.2% |
| Teamwork skills | 18.8% | 7.8% | 7.5% | 16.7% |
| Planning and organisation skills | 3.8% | 2.9% | 35.6% | 32.9% |
| Leadership skills | 2.1% | 0.7% | 31.4% | 29.5% |
| Independence | 23.0% | 13.3% | 7.5% | 15.5% |
| Creativity | 1.3% | 0.5% | 11.7% | 13.0% |
| Initiative | 1.3% | 2.0% | 7.9% | 9.7% |
| Dealing with change | 1.7% | 2.6% | 19.7% | 10.9% |
| Accuracy | 3.3% | 12.7% | 9.2% | 2.3% |

The most frequently mentioned competencies with adequate coverage were: expert knowledge, profession-specific skills and communication skills. The non-PBL graduates mentioned expert knowledge more often than did their PBL colleagues (82.9% versus 72.0%). Communication skills were ranked among the adequately covered competencies by the majority of the PBL graduates (82.8%), but only by a minority of the non-PBL graduates (41.1%).

The top 3 competencies with insufficient coverage were the same for both groups: namely, working with computers, planning and organisation skills, and leadership skills. Graduates of the PBL school mentioned those competencies more often than their non-PBL colleagues. More than a quarter of non-PBL graduates (28.2%) put communication skills in this category, whereas only a very small percentage of PBL graduates (3.3%) did so.

Most graduates stated that knowledge had been acquired in medical school, whereas profession-specific skills, ability to work in a team and planning and organisation skills had been learned in the workplace (Table 5).
Significant ($P<0.01$) differences between PBL and non-PBL graduates were found for profession-specific skills, communication skills and teamwork. Compared with the non-PBL graduates, more PBL graduates indicated that they had acquired profession-specific skills in medical school and fewer indicated that they had learned those competencies in the workplace. More than half of the PBL graduates indicated that they had acquired communication skills mainly in medical school, whereas only a quarter of the other graduates gave this response. About half of all the graduates indicated that teamwork had been learned at work. The percentage of students who said they had learned teamwork mainly in medical school was significantly higher among the PBL

graduates than among the non-PBL graduates.

Table 5: Graduates' opinions about where they had learned competencies (at school, at work, elsewhere or not applicable). Numbers represent percentages of graduates that indicated school, work or other as the place where they acquired the competency.

| | PBL graduates | | | | | Non-PBL graduates | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Competencies | n | School | Work | Other | N/A | n | School | Work | Other | N/A |
| Expert knowledge | 232 | 67.7 | 31.0 | 1.3 | 0.0 | 884 | 64.5 | 33.8 | 1.5 | 0.2 |
| Profession-specific skills | 232 | 39.7 | 57.3 | 2.6 | 0.4 | 882 | 24.7 | 72.1 | 2.2 | 1.0 |
| Computer skills | 234 | 12.0 | 31.6 | 49.1 | 7.3 | 881 | 8.5 | 36.5 | 46.1 | 8.9 |
| Communication skills | 232 | 53.9 | 23.3 | 22.0 | 0.9 | 875 | 22.4 | 36.1 | 38.5 | 3.0 |
| Teamwork skills | 232 | 19.4 | 53.0 | 27.2 | 0.4 | 881 | 5.8 | 57.7 | 32.3 | 4.2 |
| Planning and organisation skills | 231 | 8.2 | 53.2 | 34.2 | 4.3 | 883 | 6.0 | 49.9 | 38.8 | 5.2 |
| Leadership skills | 232 | 2.2 | 47.0 | 31.9 | 19.0 | 886 | 2.1 | 47.7 | 31.3 | 18.8 |
| Independence | 232 | 15.9 | 46.6 | 34.9 | 2.6 | 884 | 9.2 | 51.9 | 36.0 | 2.9 |
| Creativity | 230 | 7.4 | 28.7 | 51.7 | 12.2 | 882 | 4.1 | 30.2 | 51.7 | 14.1 |
| Initiative | 230 | 10.0 | 38.3 | 48.7 | 3.0 | 883 | 5.3 | 40.2 | 48.5 | 6.0 |
| Dealing with change | 231 | 8.7 | 42.0 | 42.9 | 6.5 | 880 | 5.3 | 51.7 | 37.0 | 5.9 |
| Accuracy | 228 | 19.7 | 36.0 | 39.5 | 4.8 | 882 | 20.1 | 38.3 | 37.6 | 4.0 |

* Significant difference between PBL and non-PBL graduates, $P < 0.01$

## Discussion

The purpose of this study was to explore junior doctors' perceptions regarding their training in the general competencies required in practice and compare the perceptions of PBL graduates with those of non-PBL graduates. Although differences between non-PBL schools may be substantial, the non-PBL schools in this study offered very similar curricula at the time of the data collection for this study, in that their programmes were predominantly lecture-based and teacher-centred, in contrast to the PBL school's small group, student-centred programme. Thus, it seems safe to assume that the differences between the PBL school and the other schools exceeded those between the non-PBL schools.

The majority of the respondents from these 5 Dutch medical schools appeared satisfied with the connection between school and work. The graduates from the PBL medical school gave significantly higher ratings for the quality of their medical training than did the graduates from the traditional schools.

Competencies considered to be of great importance by all the respondents were expert knowledge, profession-specific skills, communication skills, teamwork skills, and independence and accuracy. There were some small, albeit significant, unexpected differences between PBL and non-PBL graduates. Various explanations are possible for the differences between the two groups of students with respect to the perceived working environment: different schools may attract students with different profiles; schools may differ in the extent to which certain competencies are dealt with in the

curriculum, and students may hold different jobs after graduation. Further research will need to establish whether there is a relationship between the type of curriculum and these differences in graduates' perceptions.

Graduates of both PBL and non-PBL courses agreed on the competencies that had received either sufficient (expert knowledge, profession-specific methods and communication skills) or insufficient (working with computers, planning and organisation, and leadership skills) coverage in the undergraduate curriculum.

There was considerable variation in the responses to the question about the setting where the competencies had been acquired. Not surprisingly, most graduates indicated that knowledge had mainly been acquired in medical school. The fact that profession-specific skills had mainly been learned in the workplace can be explained by the fact that undergraduate medical training prepares students for general skills and methods, whereas many specific skills and methods are learned during specialty training.

A striking difference between the PBL and the non-PBL graduates was that the first group had learned communication skills primarily in medical school, where the curriculum had provided adequate coverage of those skills, whereas many of the non-PBL graduates had learned communication skills on the job or elsewhere. This is not surprising in the light of the extensive communication skills component of the Maastricht undergraduate curriculum.19 One may wonder, however, whether this result can be attributed to characteristics inherent in PBL or whether it is due to the longitudinal communication skills programme at the Maastricht Skillslab.

The setting in which teamwork was mostly learned also differed between the two groups of graduates, with more PBL graduates mentioning medical school as the place where they had learned to work in a team. Nevertheless, the majority of graduates indicated that teamwork skills had been learned on the job and not in school. A possible explanation is that until they enter clinical practice, junior doctors have never really worked in a team. Although the tutorial groups in the PBL curriculum resemble teams to some extent, they do not really need to function as a team. They discuss problems and the outcomes of self-study in the group, but they study independently and do not have to rely on other students for passing examinations. Another setting that might be seen as offering experience in teamwork refers to clinical clerkships. However, as clerks, students are not seen as full team members with responsibilities of their own, nor do they have to direct others. Other studies of teamwork have produced variable results. Mann and Kaufman reported no significant differences in perceptions of preparation for teamwork.[20] Hannon found that junior doctors perceived themselves as adequately prepared for teamwork in a general sense, but insufficiently so for certain skills, such as using strategies to facilitate teamwork.[5] A recent study by Willis et al. showed some differences between graduates from traditional and innovative curricula in that it found some evidence that the innovative course enhanced students' awareness of their own limitations and abilities to act as professionals alongside other team members.[21] In order to prepare students better for working in a team, teamworking skills should receive explicit attention in the undergraduate curriculum.

Although PBL is purported to enhance students' general competencies, such as independence and the planning and organising of work, we found no significant differences between the two types of school in these competencies.

All graduates appeared to be satisfied with their education as far as knowledge and skills were concerned. The greater satisfaction with communication skills expressed by the PBL graduates may be due to curriculum factors not specifically related to PBL characteristics. An unexpected result was that no differences were found between the 2 types of school for the ability to work independently, the development of which is a characteristic outcome of PBL.

A cause for concern is the apparent failure of medical schools to provide students with adequate preparation with respect to many general competencies that doctors need in their day-to-day work, such as working independently and accurately. Using computers, planning and organising work, and leadership skills were identified as competencies with insufficient exposure in the curriculum. This is consistent with a Dutch national report on medical education, which concluded that undergraduate medical training is "too focused on individual acquisition of theoretical knowledge, and despite the explicit attention for interpersonal, communication and social skills in the new curricula... this development is in need of further expansion".[22] The CanMEDS project included general competencies in its description of the required skills for doctors,[23] but there is not much evidence that medical schools have adapted their curricula to equip students with those skills. In order to improve the transition from school to practice, medical educators should give a more prominent place in the curriculum to other competencies besides knowledge. Skills such as teamworking, and planning and organising work should be incorporated into undergraduate training.

A limitation of this study is that the results are based on self-assessment. However, although self-assessment does not always provide objective information, there is some evidence that it is more reliable than asking experts or colleagues.[24] The response rate was low (45%), but quite reasonable for a large population survey. We are confident that the number of responses was sufficiently large to obtain representative information. The overriding conclusion is that junior doctors need more preparation for the general competencies required in practice. Specific attention to such competencies in undergraduate medical training appears to be effective. The results of this study show that PBL really does enhance the level of skills displayed in general competencies such as communication skills and teamwork. However, other competencies, such as planning and organising work are in need of more explicit attention in undergraduate medical training.

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# Verantwoordelijkheden van de basisarts

Als co heb je niets te zeggen en hobbel je maar een beetje achter de assistent aan, je hoeft zelden zelf beslissingen te nemen. Het meeste wat je doet wordt nog eens overgedaan. Je bent vooral bezig met ziektes, diagnose stellen en ziektebeeld bestuderen. Als arts-assistent sta je er ineens alleen voor. Bij het inwerken leer je vooral praktische zaken als wat hoort waar en waar staat de fax en dergelijke. Maar niet inhoudelijk. Maar je moet wel beslissingen nemen. De eerste weken vond ik daarom niet leuk, ik was alleen maar bezig mijn hoofd boven water te houden.

(citaat focusgroep onderzoek)

# 7

# Junior doctors' opinions about the transition from medical school to clinical practice: A change of environment

Published as: Prince KJAH, Van de Wiel MWJ, Van der Vleuten CPM, Boshuizen HPA, Scherpbier AJJA. Junior doctors' opinions about the transition from medical school to clinical practice: A change of environment. Education for Health 2004; 17(3); 323-31.

## Abstract

Concerns have been growing about the effects of the working environment on junior doctors and the learning opportunities available to them. In order to identify problems and opportunities for improvement, we explored junior doctors' opinions about the transition from student to practitioner.

Seventeen recent graduates in four focus groups discussed the transition. Related comments were combined in the report of the discussions, which was approved by the participants.

The transition was perceived as a major change, particularly the increased responsibility and workload and contacts with other health care workers and patients. Preparation during undergraduate training was adequate as regards knowledge, communication, history taking and physical examination skills but not for pharmacological knowledge and patient management skills. Problems were connected with practical procedures and feelings of uncertainty. There was little formal education. Proposals to ease the transition were earlier patient contacts, more involvement in patient management and growing responsibility during clerkships.

Although the sample was small, the uniform opinion in all groups supports the validity of the findings. Junior doctors felt confident with regard to knowledge and skills, but experienced difficulties with patient management, practical matters and their role on the team. Contrary to the idea of an educational continuum, formal learning appeared to be very limited in the hospital environment.

Preparation for medical practice may benefit from active involvement of clerks in patient management decisions and a gradual increase in responsibilities. An effective medical education continuum would require more attention for house officers' learning.

## Introduction

Growing concern has been expressed about the effects of the hospital as a working environment on junior doctors.[1-5] The heavy workload and long hours are particularly worrisome.[4-6] Junior doctors themselves have mentioned their rudimentary organisational skills, extreme workload, stress, depression, inadequate supervision and insufficient support from senior staff.[1-3, 6, 7]

Most studies of undergraduate training as preparation for medical practice have focused on knowledge and skills.[1, 2, 8-14] Although junior doctors generally express satisfaction in these regards,[10,14] there is also evidence of perceived deficiencies in skills, ranging from practical procedures and clinical skills to attending to dying patients.[1, 5, 10] Non-cognitive personal variables and attitudes, as well as team work and independent learning skills, have received little attention from researchers.[6,10]

There are also grounds for concern about the learning opportunities for house officers. Junior doctors appeared to spend much time on administrative and organisational tasks and relatively little time on formal medical training.[1, 2, 5] To date, this issue has remained underexposed. A better understanding of how junior doctors perceive the transition from student to doctor may help to identify gaps in the medical education continuum. For this purpose, we explored doctors' perceptions of this transition through focus group interviews.

## Method

### Focus group interviews

Focus group interviews are an established method to obtain qualitative information for orientation studies of new fields.[15-17] They can elicit a variety of opinions. The interaction in the group interviews helps participants explore and clarify their views in ways that would be less accessible in one-on-one interviews. The reliability of the data is established by comparing statements across sessions. Similar results of different focus groups provide triangulation of the information obtained. Additional group sessions are held until no new information emerges.

### Subjects

We conducted this study on the transition between clerkship and postgraduate training or non-training posts (house officership) among graduates from Maastricht Medical School, the Netherlands. Maastricht Medical School offers four years of theory oriented problem-based education and extensive training in the skills laboratory, followed by two years of clerkships in hospital departments and general practice. Although graduates are qualified to practise medicine under supervision, completion of vocational training in general practice (3 years) or another specialty (up to 6 years) is required to practise medicine independently. Specialty training is the responsibility of the professional organisations and is mostly work-based with some formal education. Before choosing a specialty, many graduates take a non-training post. This educational pattern is similar for all Dutch medical schools.

We sent letters to 92 junior doctors, who had graduated in the same seven

month period, explaining the purpose of the study and inviting them to participate. Of 62 (57%) respondents, 7 refused to participate, 29 were excluded due to not practising medicine or living too far away, 4 were unavailable on selected dates and 5 failed to turn up, leaving 17 participants in four focus groups (3-4-4-6). Women comprised 82% (n=14) of participants. Work experience averaged 4.8 months (range 1-7 months) and work settings varied, i.e. emergency department, psychiatry, cardiology, internal medicine, surgery, gynaecology, intensive care, public health and transplant team.

### Procedure

The moderators of the two-hour group interviews were MW, a psychologist with considerable experience in focus group research, and KP, first author and assistant moderator. Participants were asked to describe what had gone well, what problems they had encountered and how they had dealt with those during their first weeks as a house officer, with particular attention for the effects of the transition from clerk to house officer. They were also asked to comment on the undergraduate curriculum and their present learning opportunities in light of their experiences so far. Finally, they were invited to propose ways to ease the transition from clerkship to house officership.

### Data collection and analysis

The assistant moderator used the videotapes of the sessions to prepare an abridged transcript, containing comments directly related to the topic at hand plus the first moderator's summary of each topic. The moderators discussed the transcript, and modifications were made. Next, related comments were combined, and the resulting report was discussed by the moderators. All participants were asked to verify that the report of their session was accurate and complete. After this validation procedure, the data were aggregated.

## Results

Participants in three focus groups characterised the step from clerk to house officer as the most crucial transition since entering medical school. The main themes that emerged from the focus groups were: changes in responsibility, workload and work content; relationships with patients and health care workers; preparation by undergraduate training, problems related to practical procedures and feelings of uncertainty; (formal) learning; and suggestions for making the transition less burdensome.

### Increased responsibility

All focus groups mentioned 'increased responsibility' as a major change with positive and negative effects. They appreciated being taken seriously as house officers:

> "..if I say:' left', everybody goes left" and "my policy is the policy",

but increased responsibility brought strong feelings of uncertainty.

> "At the beginning of this job I did not know more than I did as a clerk, but suddenly I had to take decisions"
>
> "As a clerk I trailed along behind the house officer, occupied with how to behave and act; now that I'm a house officer myself I suddenly have a job to perform with accompanying responsibilities"

They were often uncertain what to do themselves and when to call their superior, particularly in emergencies. Generally, they thought they should try as best they could to manage on their own. Lack of experience with disease management, treatment and clinical decision making exacerbated their uncertainty.

"As a clerk it was a big thing to make a diagnosis, but now, all of a sudden I am also responsible for the right diagnosis and the right treatment"

**Workload and content**

Except for three graduates who did not work evenings and nights, the participants thought the working hours were extremely long. In the hospital with on-call rosters, most graduates worked many more hours than officially accounted for. They were reluctant to complain for fear of being rejected for training posts. The free evenings without the need to study and exams to prepare were an improvement from clerkship.

Most participants reported that organising and paperwork, such as filling out papers, ordering tests and dictating letters of discharge, were a major part of their job. Their work was more demanding than clerkship, due to the long hours and increased responsibilities. The burden was alleviated when superiors were good coaches and shared responsibilities. Initially, uncertainty about what was expected of them took a heavy toll on their energy. They thought that they received insufficient feedback to alleviate their uncertainties.

**Relations with others**

Longer rotations compared with clerkships enabled the participants to build better relationships with patients and staff. One participant said:

"finally I could stop shaking hands every week".

The participants enjoyed patient contacts. Changes compared with clerkship were increased responsibility and the task of giving information to patients. The participants enjoyed being part of a team. As clerks their position was vague and at the bottom of the hierarchy, but now their position was above the nursing staff. Relations with nursing staff varied. The participants felt uncomfortable about some nurses being far more experienced than they were.

"Nurses know a lot, which can be very useful to rely on, but also annoying because you're 'above' them in the hierarchy".

Senior staff were regarded as 'bosses'. Relations with superiors varied depending on the person. Some participants consulted their superiors frequently, others only rarely. The majority said they received little guidance. The lack of uniformity between supervisors was experienced as problematic.

Participants enjoyed contacts with fellow house officers. They felt supported when they could share experiences. Participants, who were not part of a team, felt they lacked this kind of support.

**Preparation**

History taking and physical examination skills posed no problems. Some participants mentioned feeling more skilled in history taking than their superiors. They felt well prepared for communication skills and found new tasks, like giving information and explaining findings to patients, relatively easy to perform. Despite some initial anxiety, most graduates discovered that their knowledge was satisfactory:

"Remarkable how much one in fact already knows."

However, they had difficulty interpreting findings from history, physical and other diagnostic data, like x-rays. The desirability of better preparation for working independently was keenly felt. One participant said:

"(In my experience I have) good medical knowledge, social and clinical skills.However, there was no gradual build up of responsibilities, no guidance in learning to work independently and in taking decisions."

**Difficulties**

Difficulties were mostly perceived concerning practical procedures, such as adjusting blood glucose levels, prescribing medication and filling out papers. Although the participants said they had quickly learned how to perform these tasks just by doing them, their initial lack of preparation poses a potential risk of serious problems.

"In the middle of the night, I had to adjust a drug dosage for a patient. It was not difficult, but I hadn't done it before, and I had to wake my supervisor"

In general, participants discovered to their surprise that their basic knowledge was sufficient and that knowledge they thought had vanished could be recalled pretty quickly. Real gaps in knowledge concerned prescribing medication, particularly in non-standard situations.

"I wanted to prescribe 10 mg of normison (the regular dose) for a patient with sleeping disorders, until the nurse told me that this patient took a thirty-fold dose during the day, now what?"

".. at which heart rate can you still give a ß-blocker?"

Most of the difficulties concerned facts about treatment not easily found in books. These were rapidly resolved, however, by practical experience and the use of guidelines or protocols.

**Learning and the learning environment**

Only one or two participants saw learning as an essential part of house officership. The others thought their principal task was to provide health care, with learning taking second place. Only few organised educational activities were reported.

After work the participants were too tired to do much studying. They only searched information to solve immediate clinical problems, but were hoping to have more time for in-depth study later.

Feedback came in the form of clinical outcomes or was given by supervisors intent on ensuring good patient care but not for the purpose of furthering the house officers' learning.

Participants with several months of experience reported having learned about assessing the seriousness of an illness and accepting uncertainties and responsibilities. They had learned to think in terms of differential diagnosis and therapy.

One focus group emphasised that the knowledge they acquired now was retained much better than when they were students, because they needed the knowledge not to pass an exam but to treat real patients. Moreover, longer rotations meant that they saw similar problems more frequently, which made knowledge easier to retain.

### Suggestions for improvement

Participants suggested improvements regarding content and structure of undergraduate education. They asserted that more patient contacts in the pre-clinical phase would enhance motivation and strengthen links between knowledge and practice, leading to more robust knowledge. More involvement of clerks in management and therapeutic decisions would provide better preparation for full responsibility as house officers.
Clerkships should provide a gradual increase in responsibility to facilitate the acquisition of knowledge about treatment and everyday practicalities, which the participants had learned by being "thrown in at the deep end".

## Discussion

The small sample, with slight over-representation of women, may not be representative. However, the identical outcomes from the different focus groups provide triangulation of the information obtained. Although overestimation of problems seems inevitable in a study like this, the results suggest inadequate preparation for practice and deserve the attention of medical educators.

Participants' perceptions of unsatisfactory features of the work of a house officer largely mirror concerns stated in the introduction. For the majority, the most salient change from clerkship was the sudden, huge increase in responsibility. They were expected to make decisions about management and treatment, whereas as clerks they had never been expected to think about therapy. This finding is in line with studies by Clack, which showed that graduates experienced a lack of emphasis on patient management as compared with diagnosis during clinical training.[10]

The main deficiencies in knowledge perceived by the participants concern pharmacological and practical procedural knowledge, which are not addressed during clerkships. They recommended inclusion of training in practical procedures in the undergraduate curriculum. This supports the conclusions of Calman and Donaldson and Bogg et al..[1,5] The participants also thought themselves ill prepared for multidisciplinary work, and teamwork and management skills.

The new responsibilities increased the perceived workload, which might be alleviated by good coaching and clarity about expectations. Unfortunately, only a few participants reported receiving such support.

The absence of emphasis on learning is also reason for concern and confirms findings by Bogg et al..[5] They reported that on average participants spent weekly about 5% of their time on organised, formal education. Our results suggest that house officers' learning occurs as a by-product of clinical work.

To ease the transition, participants recommended more active involvement of students in patient management decisions during clerkships. This is supported by a study by Xu et al., who found that students who reported playing an active role in teaching rounds, work rounds or conferences were more likely to be satisfied with their overall clerkship experience.[18] The importance of active learning is reflected in the participants' experience that, compared with exams, patient care is a superior context for furthering retention of knowledge. The participants recommended a gradual increase in responsibility in the course of clerkship rotations. This is in line with advice by the Educational Review Committee in the Netherlands that clerks should have at least four weeks in which they examine, treat and manage patients independently, under careful and expert supervision.[19]

## Conclusions

Despite having completed basic medical training, graduates' medical education is far from finished. Contrary to the idea of an education continuum, the participants in this study reported little formal learning. House officers' everyday reality seems far removed from the ideal training environment, where proficiency is gained gradually over a period of time and under supervision.

It is in the interest of the care provided by junior doctors that the transition from clerk to house officer is made less abrupt. A logical approach appears to be more emphasis on patient management and a gradual increase in responsibility during clerkship.

The results of this study seem to suggest a need for a new educational model where clerks and house officers can gradually move from learning by working to on-the-job learning.

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# Algemene vaardigheden

**Als co was ik alleen met geneeskunde bezig, nu ook met administratie, beddenplan, familiegesprekken enzovoort. Het uitvoeren van lichamelijk onderzoek is geen probleem en de gespreksvaardigheden zijn er goed ingestampt. Maar organiseren van nazorg? Ontslagbrieven dicteren? Leiding geven? Dat heb je in de co-schappen nog nooit gedaan.**

**(citaat focusgroep onderzoek)**

# 8
# Discussion

Medical schools have to adapt to the changes in the world. Of particular relevance to medicine are the rate of increase in new information and the demand of today's learners for learning resources that are convenient and readily available. In the last decades numerous innovations have been introduced in medical education. One of these innovations, which has spread across the world is problem-based learning (PBL).

In medical education, students experience two major transitions: the transition from preclinical student to clinical clerk and the transition from undergraduate medical training to postgraduate medical (specialty) training, i.e. from student to junior doctor. PBL is supposed to ease the transition from theory to practice, but there is not much evidence that PBL better prepares students for practice.[1]

The aim of this thesis was to answer the questions: *How do medical students and graduates experience these transitions and what is the effect of PBL on the transition?*

We focused on one particular PBL medical school and examined the perceptions of students and graduates. Several studies compared PBL-students and PBL-graduates with their non-PBL colleagues. Other studies took a more in-depth look at the transition.

This chapter starts with a discussion of the transition from preclinical medical student to clerk, as investigated in Chapters 2 and 3. In this section, we will also discuss the results of the anatomy studies. Next we examine the results of the studies that explored graduates' opinions about the transition from undergraduate medical training to working as a junior doctor. The limitations of the studies presented in this thesis and suggestions for future research will be discussed as well. The final part of this chapter describes the conclusions and implications for practice.

## The transition from the pre-clinical to the clinical phase of the *curriculum*

Most Dutch undergraduate medical curricula consist of six years. At the time the studies in this thesis were carried out, most schools had divided these six years into four preclinical, mainly theoretical years (PBL or not) and two years of clerkships. We examined how 4th year students from the Maastricht PBL medical school perceived their preparedness for practice at the start of clerkships.

The students enjoyed being in real practice at last. Most students felt nervous at the beginning of the clerkships, which seemed normal because they started a new and demanding phase of their studies. The majority felt ready to begin clinical training and enjoyed the first few weeks.

The students in our studies emphasised the positive effects of real patient contacts in their training. This is in line with Brigg-Style et al., who showed that early patient experiences add enjoyment and motivation to the early years of medical school and actually help students learn.[2] A more recent systematic review on early practical experiences also showed positive

effects. According to Littlewood et al., early practical experience helps medical students learn, helps them develop appropriate attitudes towards their studies and future practice, and orientates medical curricula towards society's needs.[3] By helping students to develop interpersonal skills, early experience made entering clerkships a less stressful experience.[3]

**Professional socialisation**

The problems PBL students experienced when starting the clerkships were largely related to professional socialisation processes. They experienced a drastic increase in workload and a lack of time for studying, according to our survey. These results did not really surprise us. There is a vast difference between the programme of the first four years and the clerkships.

In the early years, students have tutorial meetings twice a week, which guide the self-study activities during the rest of the week. They also have some scheduled activities (lectures, skillslab training sessions) and for the rest they are free to schedule their time as they like. In the clerkships, students often have to be in the hospital for more than 50 hours per week, which means a considerable reduction of their free time. They are no longer fully in control of their schedules. These experiences are not related to PBL, but are the result of huge intrinsic differences between these two phases of the medical undergraduate curriculum. In order to smooth the transition for students we would recommend a more gradual transition in the course of undergraduate medical training, with students gradually spending more time in practice and less time on theoretical self study activities.

A more important (and educationally relevant) result is that students indicated that they felt uncertain about how to behave and act, mainly because they did not know what was expected of them. This obviously interferes with their learning. Students described being so busy worrying about how to behave and act that they hardly noticed what went on before their eyes. In many other professional situations it is quite normal that novices are thoroughly acquainted with their new professional environment and take part in some sort of induction programme. It is not easy, perhaps even impossible, to give students a very extensive introduction for every ward where they are placed, given the short time of most rotations. However, as an alternative educators might offer a more general introduction into the clerkships as well as more uniformity of experiences for beginning clerks.

On the other hand, one could question the structure of clerkships in general (short rotations through a variety of wards and departments). Beginning clerks in particular have a strong need for guidance and structure, which is easier to supply when they are spending more time in the same setting. This may be said to contradict the objective of clerkships, however. One could argue that the main objective is to see as large a variety of patients, diseases and workplaces as possible. In that case, exposure as a method should suffice and having many short rotations serves this purpose well. Nevertheless, the acquisition of competencies can only be achieved through active participation in clinical practice and this would be better achieved when students were to spend somewhat more time in one place.[4]

### Knowledge and knowledge application

Students considered themselves to be moderately prepared with regard to knowledge. Both a qualitative and a quantitative study (Chapters 2 and 3) showed that clerks experienced difficulties applying their knowledge in practice. The conclusion that people can possess knowledge which they seem unable to apply is not new and in line with findings in educational psychology.[5]

To explain this, students said that their knowledge was 'structured the other way around'. This was a surprising result, because PBL is supposed to enhance application of knowledge to practice situations. There are several possible explanations. Firstly, the problems used in the tutorial meetings are often very prototypical and students 'guess' what the problem is within a few minutes. As we know from psychology, the way in which a topic is taught and learned determines what students can do with the acquired information.[5,6] If students do not have to reason from symptoms to diagnosis in the tutorial meeting, they will not learn to do so until confronted with less typical cases in real practice.

Another explanation could be dysfunctioning tutorial groups. In a study by Van de Wiel et al. students indicated that they felt general dissatisfaction with the functioning of the tutorial groups.[7] In the brainstorm phase, they often do not analyse the problem (from a real problem-based learning perspective) but confined the discussion to the most probable diagnosis. The second meeting, in which students are expected to elaborate on their newly acquired knowledge, is often limited to students presenting their findings by reading aloud the summary they have made of the topic. Neither reflection nor critical analysis takes place. It is not that students are reluctant to follow the PBL process, but apparently we (the teachers) fail to stimulate and challenge them sufficiently. This effect is reinforced by the assessment system, which tests students mainly on facts and not on problem-solving. Not surprisingly, students adjust their study strategies to optimise their chances of passing.

Furthermore, in the first years of the curriculum the emphasis is on normal human functioning (Years 1 and 2) and pathofysiology (Years 3 and 4). In the clinical phase, students are expected to diagnose patients, something they are not used to. In other words, students find themselves confronted with both content and application of knowledge that is very different from what they have learned so far. It is not surprising that they should find this difficult.

Another explanation for the fact that students possess knowledge they cannot apply is related to the curricular organisation. Just like in conventional curricula, students in the Maastricht PBL curriculum learned in so-called blocked practice (all problems related to a common tractus), with often only one example of each single disease category. Evidence from cognitive psychology informs us that students should be able to practise with more than one example and encounter problems from diverse categories to practise and learn the features that discriminate an example of one class from that of another.[8] Hatala et al. showed that engaging students with many problems, which are carefully sequenced is successful to optimise learning and transfer.[8] Central to the acquisition of expertise is the opportunity for deliberate practice with multiple examples and feedback, both to facilitate

effective transfer of basic concepts and to ensure the building of an adequate experiential knowledge base.[9] The concept of deliberate practice was introduced by Ericsson and colleagues and describes training activities that are especially designed to maximise improvement in expertise.[10] How one practises is even more important than how much one practises. Essential aspects of deliberate practice are the presence of well-defined tasks, informative feedback, repetition, self-reflection, motivation and endurance. Moulaert et al. reported that some important aspects of deliberate practice appear to contribute to the performance of medical students.[11]

In conclusion, it is difficult for students to apply knowledge in practice. PBL is supposed to enhance students' ability to apply knowledge to new problems, but apparently does not quite succeed in doing so, at least in Maastricht. This can be partly explained because the potential advantages of the PBL system are not exploited to the full. To improve transfer of knowledge and application of knowledge in practice we recommend that students should be offered more purposefully designed opportunities (and support) to practise what they have learned.

**Basic sciences**

A large proportion of the PBL students surveyed in Chapter 3 reported deficiencies in their basic science knowledge, in particular in the fields of anatomy and pharmacology, which they attributed to the PBL curriculum. Based on the perceptions of these students and because outcome studies so far have shown controversial results we wanted to ascertain whether or not PBL students actually do have deficiencies in basic science knowledge. We chose to study clinical anatomy in depth (Chapter 4). Students from all medical schools in the Netherlands were questioned about their perceived levels of knowledge and tested on their actual levels of knowledge.

Contrary to the perceptions of the Maastricht students, the PBL students were found to have the same perceived level of anatomy knowledge as the students at other medical schools. Thus the uncertainty of the PBL students in the studies described in Chapters 2 and 3 is not characteristic of PBL students.

No significant differences in knowledge levels were found between the PBL school and the non-PBL schools. In other words, PBL students have similar knowledge levels compared to their colleagues from non-PBL medical schools. This is not in line with studies that show lower knowledge levels of PBL students and graduates with respect to basic sciences.[12, 13] A possible explanation is that many of these studies test general basic science knowledge, but not the knowledge of a specific area of basic science within the context of patient problems. The study described in Chapter 4 tested students on clinically relevant anatomy knowledge; all questions were related to patient cases and required knowledge as well as knowledge application. PBL is supposed to enhance this kind of knowledge and therefore the results of this study may have been different from results in the literature.[14]

In conclusion, PBL students are equally secure or insecure about their anatomy knowledge levels as their non-PBL colleagues. Moreover, their knowledge levels are more or less similar. So PBL in itself does not necessarily lead to

lower basic science knowledge levels or less preparedness, but neither does it help students to become more secure about their competencies.

There were differences between the results of the non-PBL medical schools, which may indicate that there were other reasons for higher or lower scores than differences between PBL and non-PBL education. Based on discussions with the various anatomy departments that participated in this study, we conclude that there are several factors that affect the knowledge acquired by students:

1) The amount of time spent on the subject. It is logical that the more time students spend studying a topic, the more they know about it. The students from schools where relatively more time was devoted to anatomy seemed to score more highly.

2) The moment when a topic was repeated. A topic that is studied once during preclinical studies is remembered less well than a topic that has been studied repeatedly. In Maastricht several anatomy topics return every year in the programme, are rehearsed during skillslab training sessions and revised for the OSCE at the end of the year. Hence, students repeatedly study this topic, which seems to lead to better retention of knowledge. We conclude that the connectedness of the various curriculum elements in the Maastricht PBL medical school is effective.

3) Whether or not basic science knowledge is learned in a context. At some medical schools several anatomical topics are taught by anatomists in cooperation with medical specialists. This cooperation means that students learn anatomical structures and are concurrently being informed about the relevance of the knowledge of those particular structures for clinical practice. The fact that students learn the clinical relevance of anatomy, not just names of structures, seems to enhance knowledge levels. This is in line with elements of learning theories as described in the introduction, for example encoding specificity and motivation.

To pass judgment on the absolute level of students' anatomy knowledge, an absolute standard was set by different groups of experts, according to the Angoff method. Many students failed according to the standards set by clinicians or by Year 4 medical students. The high expectations of Year 4 medical students regarding anatomy knowledge, which are reflected by the standards set by these students may be one of the causes of their uncertainty. Fewer students, but still a considerable number, would fail if anatomists or recent graduates would determine the standard. Our objective of setting an absolute standard appeared not to be realistic. Apparently, there is no such thing as a gold standard. The discrepancy between students' performance and the standards set by the experts suggest that students do not know enough, and therefore raises concern regarding students' level of anatomy knowledge. It is very well possible that similar research in other topics, such as physiology or pharmacology, would yield similar results.[15] Remarkably, the graduates in Chapters 6 and 7 did not indicate a perceived deficiency in basic science knowledge. There are two possible reasons: Firstly, they have learned a lot more in the clerkships years, which is unlikely since not much time and attention is explicitly paid to these basic sciences. More likely, these graduates have discovered that their knowledge level is sufficient for actual clinical practice.

We think that there is a more general problem in identifying the content

of medical curricula for different disciplines and establishing how much knowledge students should acquire. The differences between the standards set by the teachers (clinicians and anatomists) support this assumption. Koens et al. found that clinicians, in comparison to basic scientists, indicated that a less deep level of knowledge was necessary for medical students.[16] Various arguments can be used to explain differences between basic scientists and clinicians. Basic scientists may focus too much on in-depth knowledge that is not really necessary for clinical practice and they may be unable to relate this knowledge to the clinical context in which it is used. On the other hand, basic scientists may have a better idea what students know because they encounter students more often in the preclinical phase. Clinicians may underestimate the level of required knowledge because they forget that they have used basic science knowledge to acquire clinical knowledge. We strongly recommend that these two groups of teachers communicate more on this topic and reach a consensus. Moreover, it is important for them to realise that students become insecure when teachers set different requirements.

The objective of these studies was to enable more absolute inferences about anatomy knowledge. The comparison of PBL students with non-PBL students showed that all students are more or less equally insecure. PBL is supposed to support students in self-directed learning and in solving new problems, and thereby reduce uncertainty. This is in contrast with our findings. The Angoff study revealed that there is no such thing as an absolute standard and that such a standard is highly influenced by the people setting it. High expectations of teachers may induce uncertainty among students.

**Learning**

Students indicated that contacts with real patients highly motivated them for learning. Their learning changed from passive acquisition of knowledge in the preclinical years to more active learning during the clerkships. These results are not in line with the expectations of PBL, which presume that paper cases provide a powerful context for self directed and active learning.

The assessment system must be in line with the educational programme or curricular objectives, because assessment drives learning. When assessment is not congruent with the curriculum, students learning will be directed more by the assessment than by the curricular objectives.[17] The development of assessment methods that are capable of addressing the educational objectives uniquely associated with PBL has proved to be a difficult challenge. As we know, the advantage of problem-oriented processing for solution tasks is mirrored by an equally substantial advantage of the memory-oriented subjects for recall tasks.[5] We also know that assessment drives learning. When we test students mainly on their recall of facts, they will study for recall. At the time of these studies, the Maastricht students were given end-of-block tests that tested on factual knowledge not on application of knowledge to new problems. If we want students to direct their attention towards curricular goals, we need to bring goals, teaching/learning activities and assessment into alignment.

### Final conclusions

In general students hugely enjoy clinical practice after several theory-oriented years. The Maastricht PBL students feel sufficiently prepared as regards knowledge. However, although PBL is supposed to enhance application of knowledge to clinical problems students have difficulties applying their knowledge to problems they encounter in clinical practice. More practice in applying knowledge might help students to overcome this problem. PBL students feel deficient in their basic science knowledge, which they ascribe to the PBL curriculum. However, students from non-PBL curricula are equally insecure and have similar knowledge levels. More attention should be paid to these perceived deficiencies and uncertainty. Learning changes from passive acquisition to more active learning. We recommend adapting the assessment system to enhance more active learning and application of knowledge in earlier stages of the undergraduate medical curriculum.

## The transition from undergraduate training to postgraduate training

The majority of the graduates indicated that the connection between their training and their current job was good. The literature describes contradictory perceptions of graduates. In a study by Clack, over 70% of graduates from a UK medical school indicated that their education had satisfactorily equipped them for their medical practice.[18] On the other hand, Evans et al. indicated that newly qualified doctors did not feel prepared for pre-registration house officer (PRHO) duties and objectively were not competent in basic clinical skills.[19]

Preparation for practice and quality of training was rated significantly higher by PBL graduates than by graduates from other schools, in line with the literature.[20, 21] Apparently, PBL is effective in smoothing the transition from undergraduate to postgraduate training in the perception of recent graduates. More information is needed about graduates' preparation for practice, and particularly why graduates do or do not feel well prepared.

The focus group study gave more detailed information and showed that the transition was perceived by the PBL graduates as a major change, particularly the increased responsibility and workload. According to Evans et al., an extended introduction improves preparedness and performance of house officers.[19] As with all problems with transitions, problems can be solved on either side of the transition. It is our opinion that better preparation of students (or graduates) might start with a more extensive introduction into the workplace, but one could also look at the preparation phase and try to improve the transition from that point, for example by giving clerks gradually more difficult tasks that resemble the work of a house officer.

### Responsibilities

Problems mentioned by PBL graduates were related to practical procedures and feelings of uncertainty, particularly with regard to their responsibilities as junior doctors. In a study by Paice et al., responsibility was identified as a key issue associated with stress in the pre-registration house officer year.[22] Hesketh et al. showed a steep learning curve in graduates' learning from their undergraduate experience with regard to coping with increased

responsibility as a pre-registration house officer.[23]
A possible explanation is that students have no responsibilities until graduation. The clerkships often consist of hopping from one clerkship to another, starting afresh each time, with no gradual increase in responsibility. So until they start working as house officers, students hardly ever have to make treatment decisions or write a prescription. This problem seems easy to overcome by gradually giving students in the final phase of their undergraduate training more responsibilities with respect to these practical matters. The Maastricht Medical School has introduced a new curriculum in which students finish their undergraduate medical training by six months of working as a senior clerk with increasing responsibilities. When the first graduates of this new curriculum finish their undergraduate medical training, we recommend repeating this study to determine whether or not this new curriculum prepares students better for practical work.

### Knowledge and knowledge application

Overall, all graduates from Dutch medical schools seem to be satisfied with their knowledge. The non-PBL graduates indicated slightly more often than PBL graduates that they had adequate domain knowledge (Chapter 6). Generally, on measures of knowledge, such as national licensing examinations, PBL students do not differ too much from students in conventional curricula; they perform a little better or a little worse.[24-28] Our qualitative study (Chapter 7) showed that PBL graduates regarded their undergraduate preparation adequate with respect to knowledge in general, but not for pharmacological knowledge and patient management skills. These deficiencies appear not a matter of too little knowledge, but insufficient experience with patient management until after graduation. This finding is supported by a study by Clack, which showed that graduates experienced a lack of emphasis on patient management as compared with diagnosis during undergraduate training.[18] Pharmacology, namely prescriptions, and practical procedural knowledge (particularly in non standard situations) are not addressed during clerkships. We strongly recommend inclusion of these topics in the undergraduate curriculum, consistent with the conclusions of Bogg et al. and the Educational Review Committee in the Netherlands.[29, 30]

### Skills

No problems were reported with regard to skills. Barnsley et al. showed that self-reported levels of confidence and actually assessed performance are not closely related, so it is uncertain whether or not graduates are really well trained as regards clinical skills.[31] Remmen et al. studied the outcome of skills training at four medical schools. They found that students from a school with a longitudinal skills training programme and problem-based learning approach had significantly higher mean scores at the start of the clerkships and maintained their lead in the subsequent clinical years.[32] Apparently, longitudinal skills training seems to offer superior preparation. Therefore we conclude that Maastricht students and graduates are well prepared for clinical skills, in line with earlier research.[33, 34]

### Communication skills

Communication skills were ranked among the competencies that had been adequately covered in their training by the majority of the PBL graduates, but

by only a minority of the non-PBL graduates. And vice versa: only a very small portion of the PBL graduates indicated that communication skills deserved more attention, whereas more than a quarter of the non-PBL graduates indicated so. We conclude that the graduates from the Maastricht PBL medical school perceived themselves better prepared with respect to communication skills. This is in line with the results of the focus group interviews with the graduates from the PBL school (Chapter 7). The greater satisfaction with communication skills expressed by the PBL graduates was as expected, because of the amount of time dedicated to communication skills in the Maastricht curriculum.[34]

**More general skills**

Although a majority of graduates indicated that teamwork skills (an important competency in practice) were learned on the job, significantly more PBL graduates mentioned medical school as the place were they had learned to work in a team. The small-group learning environment apparently offers students good preparation for working in teams in their professional careers. We think that this result can be further improved if students have to cooperate more on team assignments. In the PBL school students spent considerable time in group work, but were hardly ever dependent on other group members for the results (the main purpose of the group was to discuss cases and formulate learning objectives). In order to learn to work in (multidisciplinary) teams, other assignments are necessary, preferably carried out in multidisciplinary teams. In the new Maastricht curriculum, students work more often in small subgroups in which students are dependent on their colleagues for the final result. We expect that this will prepare them better for teamwork; However, inter-professional collaboration is still not common for undergraduate students. Furthermore, during clerkships students are not really part of the medical 'team'. Hannon showed that interns developed the ability to work in a team through their work experience in the intern year.[35] Giving students more explicit roles and responsibilities in the team during the clerkships might ease this later transition problem.

Other general skills, such as planning and organising work, are in need of more explicit attention in undergraduate medical training, according to all graduates. Our results support the opinion of Bogg et al. that such skills (e.g. organizsing work, managing responsibility/delegation) should be an integral part of the medical undergraduate curriculum.[28]

In conclusion, medical training should pay more attention to general skills. PBL does enhance several general skills, such as communication skills and teamwork skills. This can be further improved by giving students more dedicated training and experience in these skills.

**Learning**

Graduates do not perceive that learning is an important part of their job. Several studies have shown that there is little time for formal education for junior doctors.[36, 37] Bogg et al. showed that the average working week was 56 hours, with 10% working in excess of this figure.[29] The average weekly proportion of time spent on formal continuing medical education was 5%. Routine administrative tasks took up 20 percent of PRHO time and were

perceived as lacking in training or educational elements. It is difficult to change these working hours since responsibility for this part of medical training in The Netherlands is not with the medical schools but with the specialty professional colleges.

### Final conclusions

All graduates, PBL graduates as well as non-PBL graduates, agreed that the link between training and work was good. PBL graduates are more positive about their preparation for practice, so it appears that PBL does support students in their preparation for practice. The responsibilities of house officers are huge, particularly in comparison to the responsibilities of students. To ease the transition from student to house officer a more gradual increase of responsibilities is recommended. In general, graduates are satisfied with their knowledge levels and ability to apply knowledge, physical examination skills and communication skills.

PBL appears to have a positive effect on general skills without losing knowledge of clinical skills. Nowadays graduates need to be more than expert clinicians.[38] It appears that graduates in general feel (rather) well prepared for the role of medical expert and professional, as described in the CanMEDS 2000 project. PBL graduates in particular feel better prepared for the role of communicator and collaborator. All graduates are in need of more training for their role as manager, health advocate and scholar.

## Limitations of these studies and suggestions for future research

Maastricht is only one example of a medical school that has implemented PBL. We are fully aware that the Maastricht curriculum as studied in this thesis is neither the ideal nor a prototypical curriculum. Therefore, we cannot generalise the results of this study automatically to other PBL medical schools in the world. Nevertheless, we think we have found some interesting results that can help to improve medical education.

Eductional interventions are generally context dependent and highly complex; i.e. many different variables interact with each other. Evaluation studies of an entire medical school or curriculum are therefore always difficult to interpret because the intervention is broad and uncontrollable. Norman pleaded for more small-scale laboratory type studies.[39] We do agree that large scale evaluation studies of curriculum effects are difficult to interpret and that it is difficult to relate outcomes to certain parts of the curriculum. So there is a need for small scale, well-controlled studies to evaluate the effect of particular educational methods. However, randomised controlled interventions provide poorer explanations for how and why particular educational interventions are effective or ineffective. In addition, it is not always easy to implement findings from research conducted within an experimental or laboratory setting to a real life educational setting and large-scale studies of the implementation of the findings in the curriculum still must be conducted to see if the findings hold op in actual practice.[40] A possible solution for educational research is design-based research (DBR). DBR is a type of research that blends empirical educational research with theory-driven design of learning environments and is aimed at better understanding how, when and why educational innovations in practice work or not.[41] In DBR not a single method of inquiry is used, but

multiple types of data are triangulated and both qualitative and quantitative methods are used.

Evaluation studies of PBL should not only focus on specific competencies, such as knowledge and skills, but also measure more general skills. What outcome measures and instruments are appropriate for evaluating PBL is still a matter of debate. Qualitative studies are required to understand the teaching and learning that occur in the different approaches to PBL and thus are invaluable. Systematic review methodology and RCTs are necessary to evaluate the effectiveness. Heijke et al. showed that specific vocational competencies positively influence the chance of getting a job for which one is trained.[42] However, more general competencies positively influence both the chance of being matched to an occupation outside the own domain and the training participation.[42]

## Conclusions and implications for medical education

### Conclusions about the transition from theory to practice

The transition from theory to practice is abrupt and has a huge impact for both students and graduates. The problems are not so much related to knowledge levels, but rather to expectations, uncertainty and the way of learning.

Generally, students are insecure about their knowledge levels, although graduates are quite satisfied with their knowledge levels. A possible explanation is that graduates have experienced that their knowledge is sufficient for practice, whereas students still have to gain that experience. Meanwhile, teachers who want to underline the importance of their subject, will tend to emphasise the deficiencies they perceive in their field of interest, which can cause uncertainty.

PBL appears to enhance the level of skills displayed in some general competencies, such as communication skills. However, other competencies such as planning and organising work, are in need of more explicit attention in undergraduate medical training. In order to ease the transition, earlier patient contacts and more involvement in patient management with growing responsibility during clerkships are advised.

Suggestions for improvement further include more patient contacts in the preclinical phase, a gradual increase in students' responsibility for their own learning and a gradual increase in students' responsibilities for patient care.

### Conclusions with respect to PBL

PBL apparently has many positive effects on students' learning: students and graduates feel quite well prepared for practice. PBL does not show differences in 'hard' outcome measures on specific competencies. However, PBL leads to better general competencies, without a loss of preparedness for specific competencies. Meng also showed that activating learning environments (such as PBL) enhances academic competencies (by Meng defined as a group of abilities such as how to deal with information and ideas, knowing how to learn) as well as discipline-specific competencies.[43]

We want to stress that PBL is not a recipe, but that it should be related to underlying concepts. The whole implementation must be appropriate, otherwise it will not work.

What works very well in Maastricht is the spiral nature of the curriculum and the link between the various parts of the educational programme, for example the link between anatomy practicals, clinical training sessions, with the same topic being repeated in tutorials or simulated patient contacts. The fact that students revise topics annually, for example in preparation for the annual OSCE, enhances retrieval and retention in memory of knowledge and skills.

Although PBL is supposed to enhance self-directed learning and confidence of students, the Maastricht PBL students and graduates are equally insecure in relation to practice. A possible explanation is that students and graduates have obtained general competencies that are useful for later practice, but that shortly after the transition to practice these competencies have not yet reached a sufficient level and staff may have expectations that are too high. We suggest that graduates should be surveyed in a later phase of their career to examine whether or not the differences between PBL and non-PBl graduates have increased or perhaps disappeared.

PBL has many promises, but the teachers need to cooperate well. In many cases, teachers do not really believe in the effects of PBL (by intuition, because they are trained in a different way themselves). Students are often sceptical as well, partially due to the information of teachers and input from regular exams. Apparently, the educational philosophy behind PBL has not yet reached all students and staff. It is the task of educationalists and teachers, not only to introduce and implement new programmes and new ways of learning but also to inform and convince both teachers and students of the reasons and underlying philosophy of PBL.

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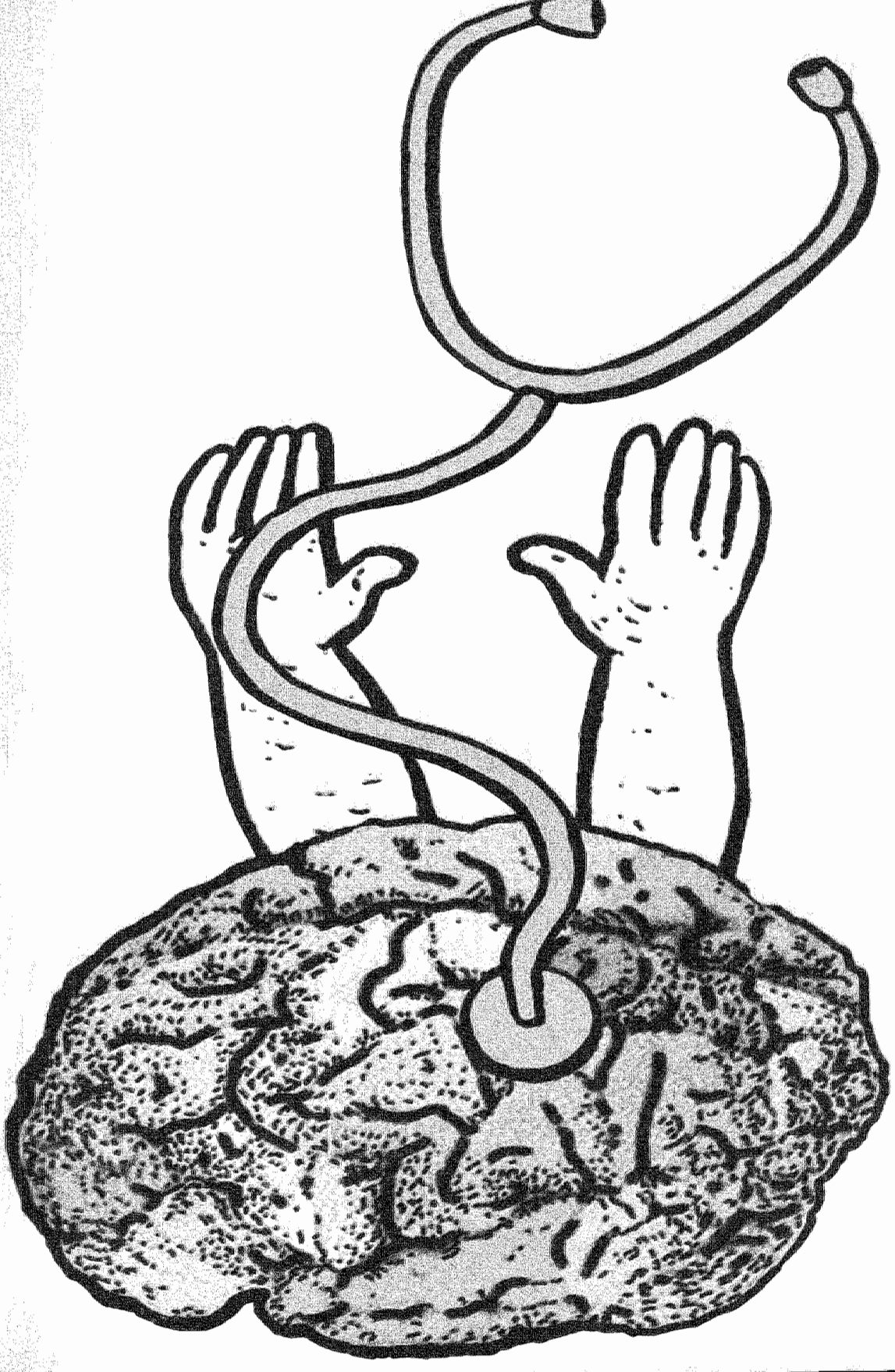

# Summary

Several developments in society in general and medicine and medical education in particular have led to a paradigm shift in medical education, which has led to the widespread introduction of student-centered curricula such as problem-based learning (PBL). In Chapter 1, the introduction, PBL is described. Here it is shown that although PBL has evolved out of the needs of professional practice, without a thorough theoretical support, it has several elements in common with contemporary educational and learning theories. PBL appears to increase the motivation of students and may lead to better self-directed learning skills. However, there is no sound evidence for PBL as a superior method in terms of better knowledge structure or problem-solving skills. This chapter also discusses possible criteria for empirical evidence. It is concluded that the key element of PBL is that it contextualises education and this makes it more relevant by connecting learning to professional contexts. Hence, one could expect that this better prepares students for practice. The studies presented in this thesis explore students' and graduates' opinions about the transition from theory to practice and how PBL helps them to prepare for practice.

Chapter 2 presents a qualitative study that explored the perceptions and attitudes of students regarding the transition from the pre-clinical phase to the clinical phase of the undergraduate medical curriculum. Year 5 students of the Maastricht Medical School participated in focus group interviews. The problems they described arose largely from professional socialisation processes. The students also indicated that they found it difficult to apply theoretical knowledge in clinical practice. Since the problem-based learning approach is supposed to enhance application of basic science concepts to clinical problems, it is surprising that students experience difficulties in applying their knowledge in practice. They found contacts with real patients highly motivating. In the clinical phase their learning changed from passive acquisition to more active learning. It was concluded that to facilitate the transition from theory to practice in the Maastricht Medical School some curricular changes could be introduced, such as early patient contacts to motivate students and help them to learn usable knowledge. Furthermore, the assessment system must be congruent with the knowledge and competence goals of the educational programme, because examinations have a powerful effect on student learning approach and outcome.

In Chapter 3 students' opinions about their preparation for clinical practice are described. To seek quantitative verification of the findings in Chapter 2 all Year 4 students at Maastricht Medical School were surveyed on the transition from pre-clinical to clinical training and its effect on workload, knowledge, skills and learning. Students indicated to be uncertain as to how to behave and act, mainly because they did not know what was expected from them. They experienced a drastic increase in workload and a lack of time for studying. They considered themselves to be moderately prepared with regard to knowledge and they regarded their physical examination skills as satisfactory. Students reported having difficulty applying theoretical knowledge in clinical practice and perceived shortcomings in basic science knowledge. In addition, they felt compelled to change their learning strategies.
The results of this study confirmed the findings of the focus group study in Chapter 2. The students experienced problems related to professional

socialisation and workload and deficiencies in knowledge and the organisation of knowledge. Suggestions for improvement are an extensive introduction into the clerkships, a more gradual transition with regard to workload and closer integration of preclinical and clinical education.
Both the qualitative and quantitative study showed that the Maastricht PBL students perceive a lack in basic science knowledge, in particular anatomy and pharmacology. Generally, the integrated PBL approach seemed to be associated with uncertainty and perceived deficiencies in terms of basic science knowledge. The study described in Chapter 4 compared the perceived and actual levels of knowledge of anatomy of PBL and non-PBL students. Although PBL students attributed their perceived deficiencies in basic science knowledge to the method of their curriculum, PBL students were found not to deviate from students at other medical schools in their perceived level of anatomy knowledge. Differences in actual knowledge levels were found between schools. However, no significant differences were found between the PBL and the non-PBL schools. The results of this study show that PBL does not result in lower level of anatomy knowledge than more traditional educational approaches.

This outcome does not tell us how realistic the students' perceptions of their knowledge levels are. It remained to be ascertained whether the levels students attain are adequate. To allow judgment on the general level of students' anatomy knowledge an absolute standard was needed. Chapter 5 focuses on the comparison of students' levels of anatomy knowledge as measured in the study described in Chapter 4 with standards set by different groups of experts. A modified Angoff procedure was used to establish an absolute standard. Four panels of anatomists, clinicians, recent graduates and students, respectively, judged 107 items of the anatomy test. The outcomes in Chapter 4 were compared with the standards obtained by the panels. If the standard established by the panel of Year 4 students would be used, 64% of the students failed the test. The standards established by the anatomists, clinicians and recent graduates would yield failure rates of 42%, 58% and 26%, respectively. According to these panels' standards, many students did not know enough about anatomy. The high expectations that the Year 4 students appeared to have of themselves may have contributed to students' uncertainty about their level of anatomy knowledge.

Chapter 6 presents a study into the opinions and perceptions of graduates form PBL and non-PBL schools on how well their training had prepared them for medical practice. The responses of 1159 graduates from one PBL and four non-PBL schools to a questionnaire survey administered 18 months after graduation were analysed. Compared with their non-PBL colleagues, the PBL graduates gave higher ratings for the relation between school and work, their medical training and preparation for practice. According to the graduates the most frequently used competencies that were sufficiently covered during medical training were domain knowledge, profession-specific skills and communication skills. The majority of the PBL graduates, but less than half of the non-PBL graduates, indicated that communication skills had been covered sufficiently. All the graduates called for more curriculum attention to working with computers, planning and organisation, and leadership skills. More PBL graduates than non-PBL graduates indicated that they had learned profession-specific methods, communication skills and teamwork in medical

school. Overall, the graduates appeared to be satisfied with their knowledge and skills. The results suggest that the PBL school provided better preparation with respect to several of the competencies. However, both PBL and non-PBL graduates identified deficits in their general competencies, such as working with computers and planning and organisation of work. These competencies should feature more prominently in undergraduate medical education.

The study reported in Chapter 7 is a more in-depth analysis of the opinions of PBL graduates about the transition from student to doctor. Recent graduates in four focus groups discussed this transition. They perceived the transition as a major change, particularly the increased responsibility, the increased workload and the change in their contacts with other health care workers and patients. Preparation during undergraduate training was perceived as adequate as regards knowledge, communication, history taking and physical examination skills, but not for pharmacological knowledge and patient management skills. Problems were associated with deficient knowledge of and skill in the application of practical procedures and with feelings of uncertainty. Graduates indicated that the transition could be smoothened by earlier patient contacts, more involvement in patient management and an increase in responsibility during clerkships. Contrary to the idea of an educational continuum, formal learning appeared to be very limited in the hospital environment.

Chapter 8 presents the general discussion. The main conclusions with respect to the transition from the pre-clinical to the clinical phase of the curriculum are:

- Many problems students experience when starting their clerkships are related to professional socialisation processes.
- Although PBL is supposed to enhance application of knowledge to clinical problems, students have difficulties applying their knowledge to problems they encounter in clinical practice.
- PBL students are equally secure or insecure about their anatomy knowledge levels as their non-PBL colleagues and their knowledge levels are more or less similar.
- Learning changes from passive acquisition to more active learning.

The transition from undergraduate training to postgraduate training is also perceived as a major change, particularly the increased responsibility and workload. PBL appears to support students in their preparation for practice, by enhancing general competencies.
Recommendations for improvement include adapting the assessment system to enhance more active learning and more patient contacts and application of knowledge in earlier stages of the undergraduate curriculum. Furthermore a gradual increase in students' responsibility for their own learning and for patient care can smoothen the transition from theory to practice.

# Samenvatting in Nederlands

Verschillende maatschappelijke ontwikkelingen en met name ontwikkelingen in de geneeskunde en het medisch onderwijs hebben geleid tot een paradigma verschuiving in het medisch onderwijs. Dit heeft geleid tot wereldwijde introductie van student-gecentreerde curricula, zoals probleem-gestuurd onderwijs. In hoofdstuk 1, de introductie, wordt probleem-gestuurd onderwijs (PGO) beschreven. PGO is voortgekomen uit behoeftes van de praktijk, zonder duidelijk theoretische grondslag. Het heeft echter diverse overeenkomsten met huidige onderwijskundige en leer-theorieen. PGO blijkt de motivatie van studenten te vergroten en lijkt tot betere vaardigheden van studenten om zelf te leren. Het is echter niet bewezen dat PGO een betere onderwijsmethode is, als het gaat om kennis-structuur of probleem-oplossend vermogen. In dit hoofdstuk bespreken we ook mogelijke criteria voor wetenschappelijk bewijs. We concluderen dat het bijzondere van PGO is dat onderwijs in een context wordt geplaatst. Door het leren te koppelen aan de professionele context wordt het relevanter voor studenten. Dit zou er toe moeten leiden dat studenten beter worden voorbereid op de praktijk. De studies beschreven in dit proefschrift waren gericht op de mening en ervaring van studenten en afgestudeerden over de overgang van theorie naar praktijk. Speciaal werd gekeken naar de rol van PGO bij de voorbereiding op de praktijk.

In hoofdstuk 2 wordt een kwalitatief onderzoek beschreven naar de perceptie en houding van studenten ten aanzien van de overgang van de pre-klinische fase naar de co-assistentschappen in het medisch curriculum. Vijfdejaars studenten van de medische faculteit van de Universiteit Maastricht namen deel aan focus groep interviews. De problemen die zij benoemen komen grotendeels voort uit professionele socialisatie processen. De studenten gaven ook aan moeite te hebben met het toepassen van hun kennis in de praktijk. Van PGO wordt verwacht dat het de toepassing van basiskennis concepten op klinische problemen vergemakkelijkt. Daarom is het erg opvallend dat studenten zoveel moeite hebben met het toepassen van hun kennis in de praktijk. Studenten vonden de patiënten contacten erg motiverend. In de klinische fase van hun studie veranderden zij hun leerpatroon van passief naar een meer actieve vorm. Om de overgang van theorie naar praktijk in de Faculteit Geneeskunde in Maastricht te vergemakkelijken, gaven de studenten diverse suggesties, bijvoorbeeld vroege patient contacten om de studenten te motiveren en meer hulp om bruikbare kennis te verwerven. Verder werd aangegeven dat het toetssysteem overeen moet komen met de doelstellingen van het onderwijs, omdat examens een zeer sterk effect hebben op de wijze van leren van studenten en op het leerresultaat.

Hoofdstuk 3 beschrijft de mening van studenten over de voorbereiding op de praktijk. Om de bevindingen van hoofdstuk 2 kwantitatief te verifiëren werd een vragenlijst afgenomen bij alle vierdejaars studenten geneeskunde in Maastricht. De vragenlijst omvatte vragen over de overgang van het preklinische deel van de opleiding naar de co-assistentschappen enhet effect op werkdruk, kennis, vaardigheden en leren. Studenten gaven aan onzeker te zijn over hoe ze zich moesten opstellen, vooral omdat niet duidelijk was wat er van hen werd verwacht. Ze ervoeren een grote toename in werkdruk en een tekort aan studietijd. Ze achtten zichzelf matig voorbereid wat betreft kennis en vonden hun vaardigheden om fysisch diagnostisch onderzoek uit te voeren voldoende. Studenten gaven opnieuw aan moeite te hebben met

het toepassen van hun kennis in de praktijk. Bovendien ondervonden ze hiaten in hun kennis van de basisvakken. Ze voelden zich gedwongen hun leer strategieën aan te passen.
De resultaten van dit onderzoek bevestigden de bevindingen van het focus groep onderzoek zoals beschreven in hoofdstuk 2. De studenten ondervonden problemen gerelateerd aan professionele socialisatie, toegenomen werkdruk, en kennistekorten (qua hoeveelheid en organisatie). Suggesties voor verbetering omvatten een uitgebreide introductie aan het begin van de co-assistentschappen, een geleidelijke overgang met betrekking tot de werkdruk en meer integratie van het preklinische en het klinische deel van de opleiding.

Uit zowel het kwalitatieve als kwantitatieve onderzoek bleek dat de Maastrichtse PGO-studenten een tekort aan basiskennis ondervonden, met name op het gebied van anatomie en farmacologie. De geïntegreerde PGO aanpak lijkt samen te gaan met onzekerheid en ervaren tekorten wat betreft basis kennis. Het onderzoek beschreven in hoofdstuk 4 vergelijkt de mening van studenten over hun kennis en de daadwerkelijke kennis van PGO- en niet-PGO studenten van anatomie. Ofschoon de PGO studenten hun tekorten wijten aan het probleem-gestuurde curriculum, blijken alle studenten even onzeker over hun kennis van de anatomie en wijken PGO-studenten daar niet van af. Tussen de verschillende geneeskunde opleidingen werden wel verschillen gemeten in de anatomiekennis. Er waren echter geen significante verschillen tussen de PGO-studenten en de niet-PGO studenten. De resultaten van dit onderzoek laten zien dat PGO niet leidt tot een minder kennis van de anatomie in vergelijking met meer traditionele onderwijsmethoden.

Dit resultaat zegt echter nog niet of de ervaren tekorten van studenten realistisch zijn of niet. Met andere woorden, het staat hiermee nog niet vast of studenten voldoende kennis van anatomie bezitten. Om een uitspraak te kunnen doen over het algemene nivo van anatomiekennis van studenten was een absolute standaard nodig. Hoofdstuk 5 vergelijkt de kennisnivo's van studenten van anatomie zoals gemeten in het onderzoek in hoofdstuk 4 met standaarden bepaald door diverse groepen 'experts'. A gemodificeerde Angoff procedure werd gebruikt om tot een absolute standaard te komen. Vier groepen, bestaande uit respectievelijk anatomen, clinici, afgestudeerden en studenten, beoordeelden 107 items van de anatomie test. De resultaten in beschreven in hoofdstuk 4 werden met deze standaarden vergeleken. Als de standaard, bepaald door het panel met vierdejaars studenten zou worden gebruikt, zou 64% van de studenten zijn gezakt. De standaarden bepaald door de anatomen, clinici en afgestudeerden leidden tot respectievelijk 42%, 58% en 26% gezakten. Volgens deze groepen beoordelaars weten veel studenten dus onvoldoende van anatomie. De hoge verwachtingen van de vierdejaars studenten hebben mogelijk bijgedragen aan de onzekerheid van deze groep over hun kennisnivo.

Hoofdstuk 6 beschrijft een studie naar de ideeen en meningen van afgestudeerden van PGO- en niet PGO-opleidingen over de voorbereiding in de opleiding op de medische praktijk. De respons van 1159 afgestudeerden van 1 PGO en 4 niet-PGO medische opleidingen werden geanalyseerd. De vragenlijsten waren 18 maanden na het afstuderen afgenomen. In vergelijking met de niet-PGO afgestudeerden, beoordeelden de PGO-afgestudeerden

de overgang van opleiding naar werk en de medische opleiding en voorbereiding op de praktijk beter. De afgestudeerden gaven aan dat van de competenties die ze in de praktijk veel gebruiken domein gerelateerde kennis, vakspecifieke vaardigheden en communicatievaardigheden voldoende tijdens de opleiding aan bod waren gekomen. De meerderheid van de PGO-afgestudeerden, en minder dan de helft van de niet-PGO afgestudeerden, gaf aan dat communicatievaardigheden voldoende aan bod waren gekomen. Alle afgestudeerden gaven aan dat het nodig was meer aandacht in het curriculum te besteden aan het werken met computers, plannen en organiseren en leidinggevende vaardigheden. Meer PGO dan niet-PGO afgestudeerden gaven aan dat ze vakspecifieke vaardigheden, communicatievaardigheden en samenwerken hadden geleerd tijdens de opleiding. In het algemeen leken de afgestudeerden tevreden over hun kennis en vaardigheden. De resultaten van dit onderzoek suggereren dat de PGO opleiding studenten beter voorbereid als het gaat om diverse competenties. Zowel PGO als niet-PGO afgestudeerden beschreven tekorten inhun algemene competenties, zoals het werken met computers en het plannen en organiseren van het werk. Deze vaardigheden zouden uitgebreider aan bod moeten komen in de medische opleiding.

De studie beschreven in hoofdstuk 7 is een verdere analyse van de meningen van PGO afgestudeerden met betrekking tot de overgang van student naar arts. Artsen die recent waren afgestudeerd bespraken deze overgang in vier focus groepen. Zij ervoeren de overgang als een grote verandering, met name wat betreft de toegenomen verantwoordelijkheid, de toegenomen werkdruk and de verandering in de omgang met andere zorgverleners en patiënten. De voorbereiding tijdens de medische opleiding werd voldoende beschouwd als het gaat om kennis, communicatie vaardigheden, anamnese afnemen en het uitvoeren van lichamelijk onderzoek. De opleiding bood onvoldoende voorbereiding met betrekking tot farmacologische kennis en het behandelen van patiënten. De problemen die werden genoemd werden gerelateerd aan onvoldoende kennis en vaardigheden met betrekking tot praktische procedures en met gevoelens van onzekerheid. Volgens deze afgestudeerden kan de overgang worden vergemakkelijkt door eerder in de opleiding meer patiënten te zien, meer betrokkenheid als student bij het medisch beleid en een geleidelijke toename van verantwoordelijkheden tijdens de co-assistentschappen. In tegenstelling tot het idee van een opleidings-continuum blijkt gericht leren zeer beperkt in de ziekenhuis omgeving.

Hoofdstuk 8 bevat de algemene discussie van dit proefschrift. De belangrijkste conclusies met betrekking tot de overgang van de pre-klinische fase van het curriculum naar de co-assistentschappen zijn:

- Veel van de problemen die studenten ervaren bij aanvang van de co-assistentschappen kunnen worden toegeschreven aan professionele socialisatie.
- Alhoewel PGO de toepassing van kennis bij klinische problemen zou moeten stimuleren, hebben studenten moeite met het toepassen van hun kennis op situaties die ze in de praktijk tegenkomen.
- PGO studenten zijn even zeker of onzeker over hun kennis van anatomie als hun collega's en hebben ook vergelijkbare kennis nivo's.
- Leren verandert van passief verwerven van kennis naar veel actiever

leren.
De overgang van de geneeskundeopleiding naar het werken als basisarts wordt eveneens gezien als grote overgang, met name door de toegenomen verantwoordelijkheid en werkdruk. PGO lijkt de studenten te helpen bij de voorbereiding op de praktijk door het stimuleren van algemene vaardigheden.
Als suggesties voor verbetering worden genoemd het aanpassen van het toetssysteem zodat actief leren meer wordt gestimuleerd, en meer patiënten contacten en toepassen van kennis vroeg in de opleiding. Een verdere verbetering van de overgang van theorie naar praktijk kan worden bereikt door een meer geleidelijke toename van verantwoordelijkheid van de studenten voor zowel het eigen leren als de zorg voor patiënten.

# List of Publications

## List of publications

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# About the Author

Katinka Prince was born on September 22nd 1970 in Linschoten. After obtaining her secondary school diploma in 1988 at the Willem van Oranje College in Waalwijk, she started her study at the Faculty of Medicine at the Maastricht University. During medical undergraduate training she was a student member of several educational committees and the Faculty Board of Advisers. In her final year she did research into the communication skills of medical students. After graduation in 1996 she started working as a teacher/researcher at the Skillslab of the Faculty of Medicine, in combination with practising medicine in a nursing home. In 1998 she started postgraduate training for General Practice in combination with her PhD in medical education (a so called AIOTHO, medical doctor in training to become a General Practitioner and researcher). She finished training in 2002 and worked for 2 years part-time as a general practitioner in Utrecht. During the summer of 2002 she spent 3 months at the PERD at McMaster University, Hamilton in Canada. In 2004 she started working at the University General Practitioners Centre of the VU Medical Centre in Amsterdam. Katinka lives together with Peter Nieuwland. They have a son called Teun.

Katinka Prince werd op 22 september 1970 geboren in Linschoten. Na het behalen van haar atheneum diploma in 1988 op het Willem van Oranje College te Waalwijk, begon ze met de studie geneeskunde op de Universiteit Maastricht. Gedurende de opleiding zat ze in diverse onderwijs commissies en de faculteitsraad. In haar laatste studiejaar verrichte ze onderzoek naar de communicatievaardigheden van geneeskundestudenten. Na haar afstuderen in 1996 begon ze als docent/onderzoeker op het Skillslab van de Faculteit Geneeskunde, gecombineerd met een baan als arts in een verpleeghuis. In 1998 startte ze met de huisartsopleiding, gecombineerd met onderzoek van onderwijs (de zogenaamde AIOTHO, arts in opleiding tot huisarts en onderzoeker). De huisartsopleiding werd in 2002 afgerond en daarna werkte ze 2 jaar parttime als huisarts in Utrecht. In de zomer van 2002 bracht ze 3 maanden door op McMaster University, Hamilton in Canada. Vanaf 2004 werkt ze in de Universitaire Huisartsenpraktijk van het VU medisch centrum.
Katinka woont samen met Peter Nieuwland. Ze hebben een zoon genaamd Teun.